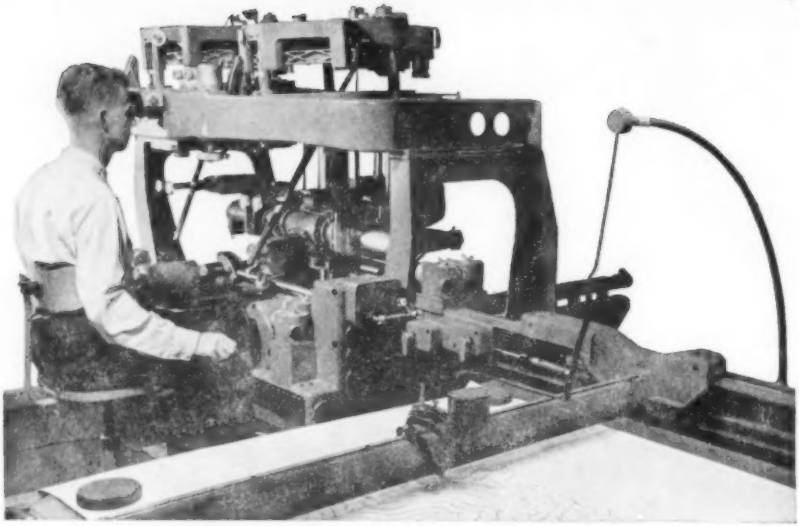
Surveying and Mapping

October – December 1953

Quarterly Journal
AMERICAN CONGRESS ON SURVEYING AND MAPPING



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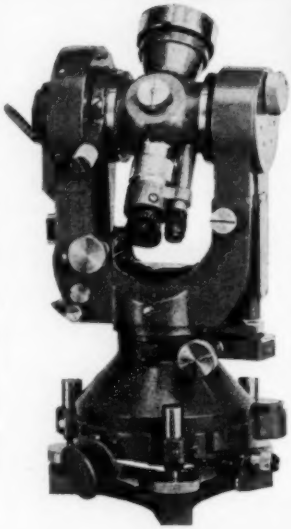

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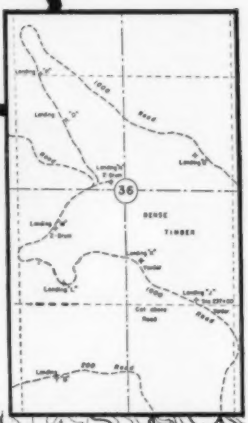

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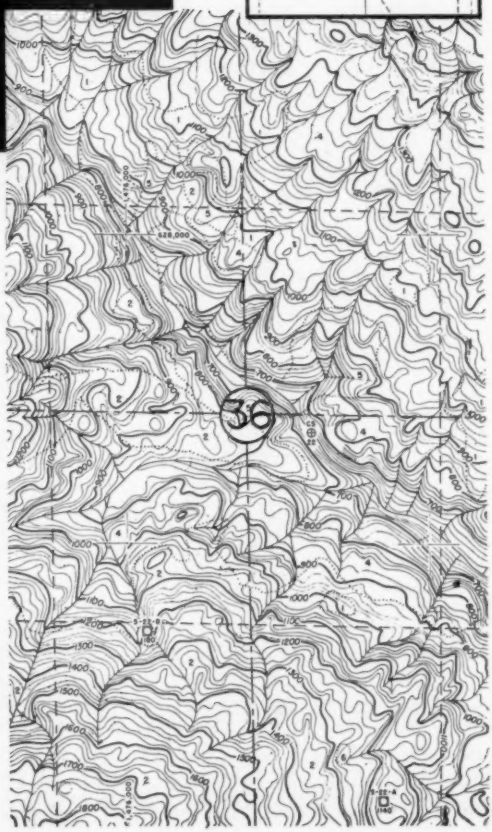

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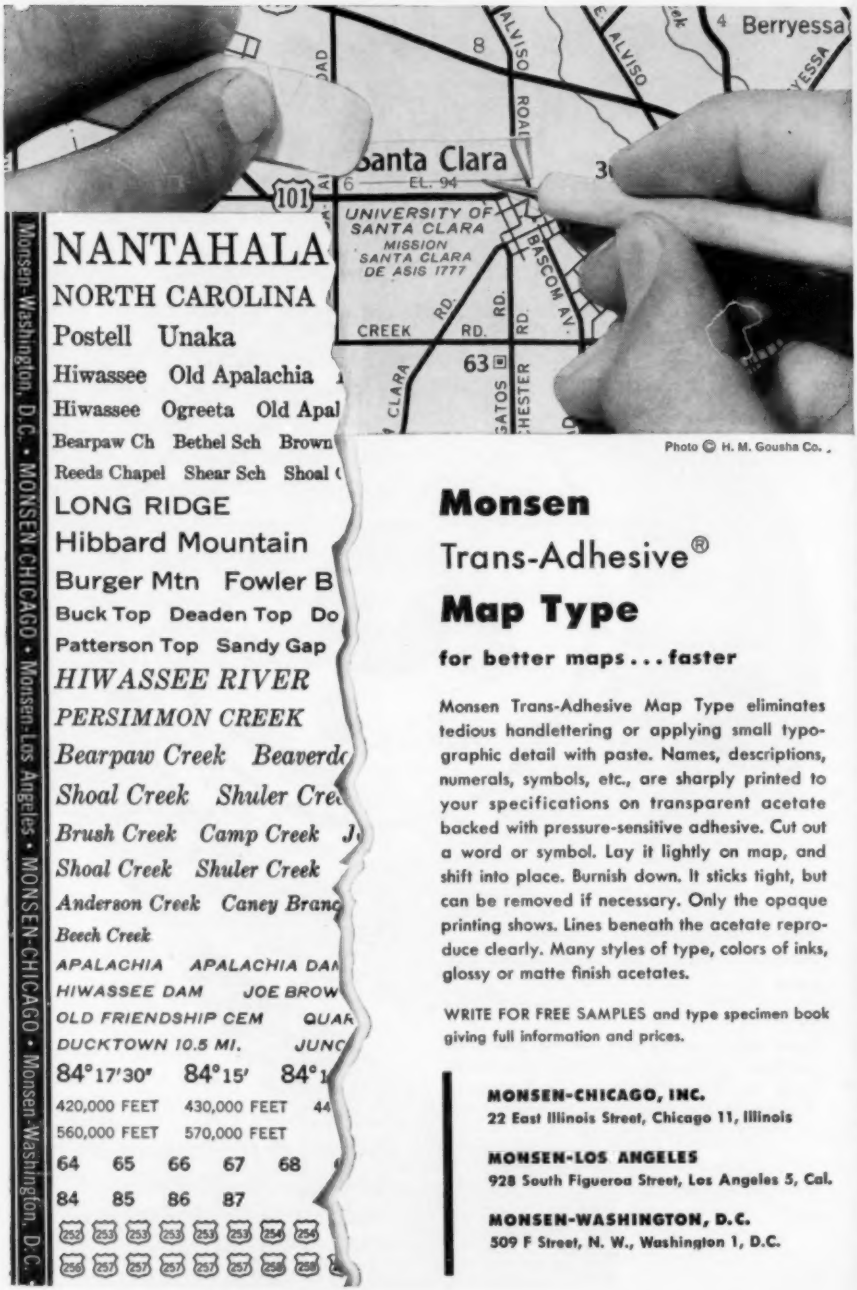

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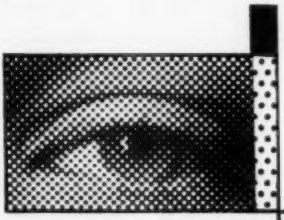

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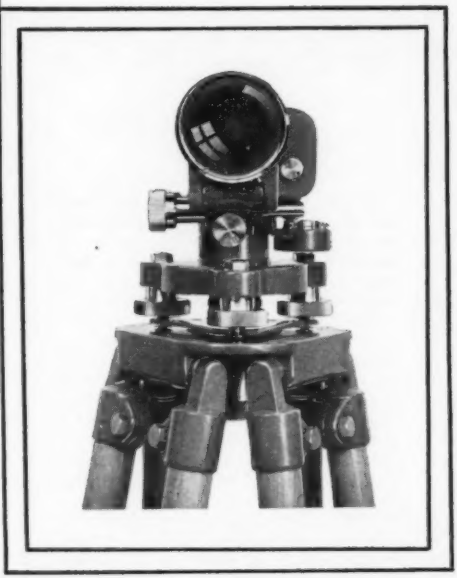

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Notekeeper: W. & L.E. Gurley, America's Oldest Engineering Instrument Maker

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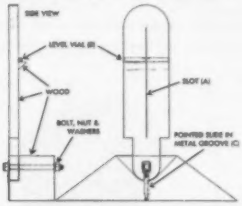

"Use good, dry hardwood. The upright section should have a 1/32" slot *(A in diagram)*, through which light is visible. A bracket on the reverse of the upright—fastened at right angles to longitudinal slot—holds a level vial *(B)*. The slot is vertical when vial is level.

"The upright section is held to a base by a pivot bolt. Also attached at the bolt is a pointed metal slide, moving in a metal groove *(C)*. This slide moves through a line which is a projection of the vertical slot. It can be extended to position the slot accurately over a point on sloping terrain.

"At night I use a three-battery flashlight, held by a wire frame behind the slot. By day, the sun is reflected through the slot by a mirror. Having used mirrors in the national forests, I recommend them for day work. For day or night work, I recommend my Gurley reticle. It makes any problem a pleasure."

Level on stilts

Have you tried this method for leveling over corn fields or groves of fruit trees? Letters from all over are telling us how surveyors are finding this short cut helpful. All you do is remove the sliding legs from your extension tripod and replace them with lengths of one-inch thinwall conduit.

"Let's give credit where credit is due," says James Ritchie, Field Engineer for Charles E. DeLeuw, Consulting Engineer, Amherst, Ohio, who used the tip on the Ohio Turnpike. "We learned about this from 'The Surveyor's Notebook', put out by Gurley, maker of the best level ever built."

Leveling over Ohio corn field.

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- *To Attend—*
- *Or Send a Representative*

Fourteenth Annual Meeting and Exhibit

March 22, 23, 24, 1954

The forthcoming Fourteenth Annual Meeting of the American Congress on Surveying and Mapping, to be held at the Shoreham Hotel in Washington, D. C., again promises to be of keen interest. Helmuth Bay, Chairman of the 14th Meeting, and his hard working program committee have scheduled top-flight papers covering the broad and diversified interests of professional surveying and mapping and the layman's use of maps and surveys. The keynote topic will be "Mapping in Our Business Economy."

Of particular interest will be the outstanding exhibit of modern survey instruments, equipment, and field and office supplies. Several new exhibitors already have entered displays, and indications are that the exhibits will be more extensive than ever.

Actual workshop demonstrations will be featured this year by the Control Surveys Division to explain new techniques in computing and adjustment. On display will be one of the fascinating Geodimeters, the use of which will be explained.

The land surveyor's interest will be whetted by the usual and sometimes controversial issues so close to the hearts of the professional surveyor. Informal round-table discussions of the Property Surveys Division will range from reactions to Chairman Ralph Berry's programmed paper, "Compulsory Property Survey Ties to State Coordinates," to the everyday issues of the profession, e.g., overlapping responsibility of the surveyor, the engineer, and the lawyer; professional ethics; land registration; legislation problems; and—close to the practical side of professional practice—fees.

The Education Division will feature a paper on the long-discussed "Prospects for a Bachelor of Science Degree in Surveying and Mapping."

Intense interest is expected to center around discussions of the current prospects for a Bachelor of Science Degree for members of our profession and the Civil Service status of persons concerned with surveying and mapping. The Cartography Division will hold an open discussion on the latter subject.

The Topography Division will feature 3 papers on various phases of mapping in Arctic areas. This cold-country mapping interest is a hot topic as man's interest in the Arctic regions is increasing each day.

The Instruments Division, besides being the backbone of the Exhibit, will have informal discussions at virtually every booth in the Exhibit Hall. More formally they will hold a round-table discussion on "Formulation of Standard Federal Specifications and Acceptance Tests for Survey Instruments."

Other papers of keynote interest will emphasize the keynote theme of "Mapping in Our Business Economy."

Make Your Reservations, Mark Your Calendar NOW

What Surveying Means to Industry

By JOHN A. WALLS

FORMER PRESIDENT, PENNSYLVANIA WATER AND POWER COMPANY

IT HAS LONG been an aim of the Pennsylvania Water & Power Company, with which I have been connected since its organization, to build substantially with a view to the future. This policy is now carried on by my successor as president, G. Whittier Spaulding, and is well exemplified in the Safe Harbor power plant, constructed under the direction of Nathan B. Higgins, now president of the Safe Harbor Water Power Corporation.

We have endeavored to find expression not only in steel and concrete but also in research and in the abstract. The organization has established a creditable record of advances, which, through contact with others have been widely shared in advancing the business of power production. At the same time, we have frequently profited from reciprocal advantages that have arisen as the result of sharing with others.

As is well known, all research, item by item, does not prove successful, but taken as a whole the benefits, I believe, far exceed the cost. Efforts have been expanded in many fields, of which surveying is but one. We have had both good and bad experience from which we have learned that, in general, it is not the things which are adequate for the time being, but those which form a good foundation for the future that are best and cheapest in the end.

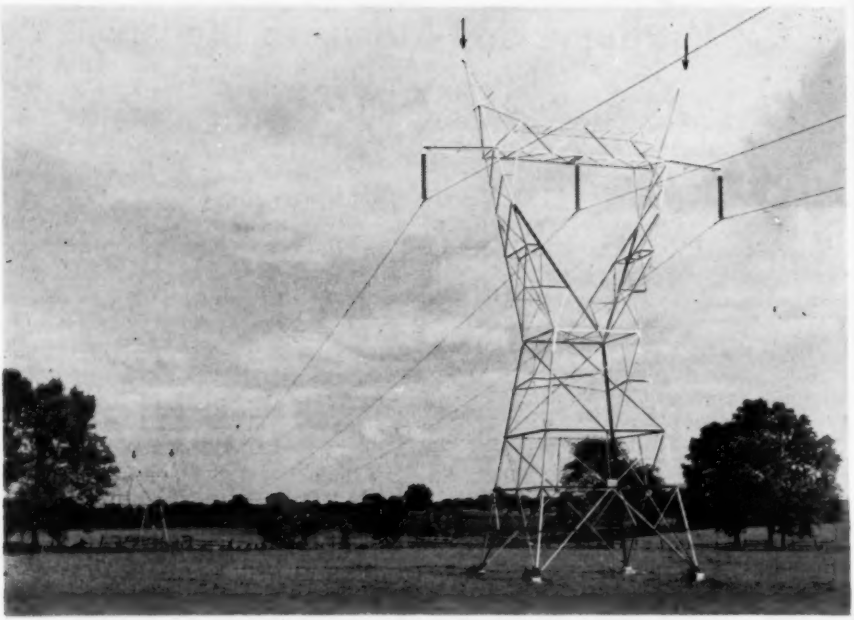
With respect to surveying we have found that stones left unturned and precautions neglected in the press of circumstances almost always prevent the fullest use of surveys that otherwise might be much more valuable than they are. Not only the surveyor himself, but also the executive responsible for each undertaking should remember that in surveying the end depends on the beginning. It is unfortunate that false economy at the start, and lack of vision as to the many purposes that reliable maps and surveys may serve, so frequently lead us to be satisfied with a "good enough for the present" policy, and that the ultimate savings in time, effort, and in avoiding costly mistakes are so often ignored.

Presented at the Thirteenth Annual Meeting, of the American Congress on Surveying and Mapping, March 23–25, 1953, Washington, D. C.

EARLY EFFORTS

At the beginning of this century financial groups interested in the possible development of power from the 225 feet of drop in water level in the 40 miles between Columbia, Pennsylvania, and tidewater in Maryland engaged the services of a very capable engineer to make a detailed survey of this part of Susquehanna River. The field work was well done and maps were produced which have proved to be excellent representations of the topography of the river bed. However, their value was at the time not appreciated and consequently they lay for years forgotten and neglected among the effects of the defunct McCall Ferry Power Company and came to light only when an old building once used by the construction forces was about to be razed. In addition, although the maps showed coordinate lines, there was nothing to indicate the connection between these lines and the control used. For all that appeared on the map these lines might have been ruled on afterwards. Nothing is known today about how the grid was established. The finished map is simply an excellent "picture" of the contours showing original rock elevations, etc.

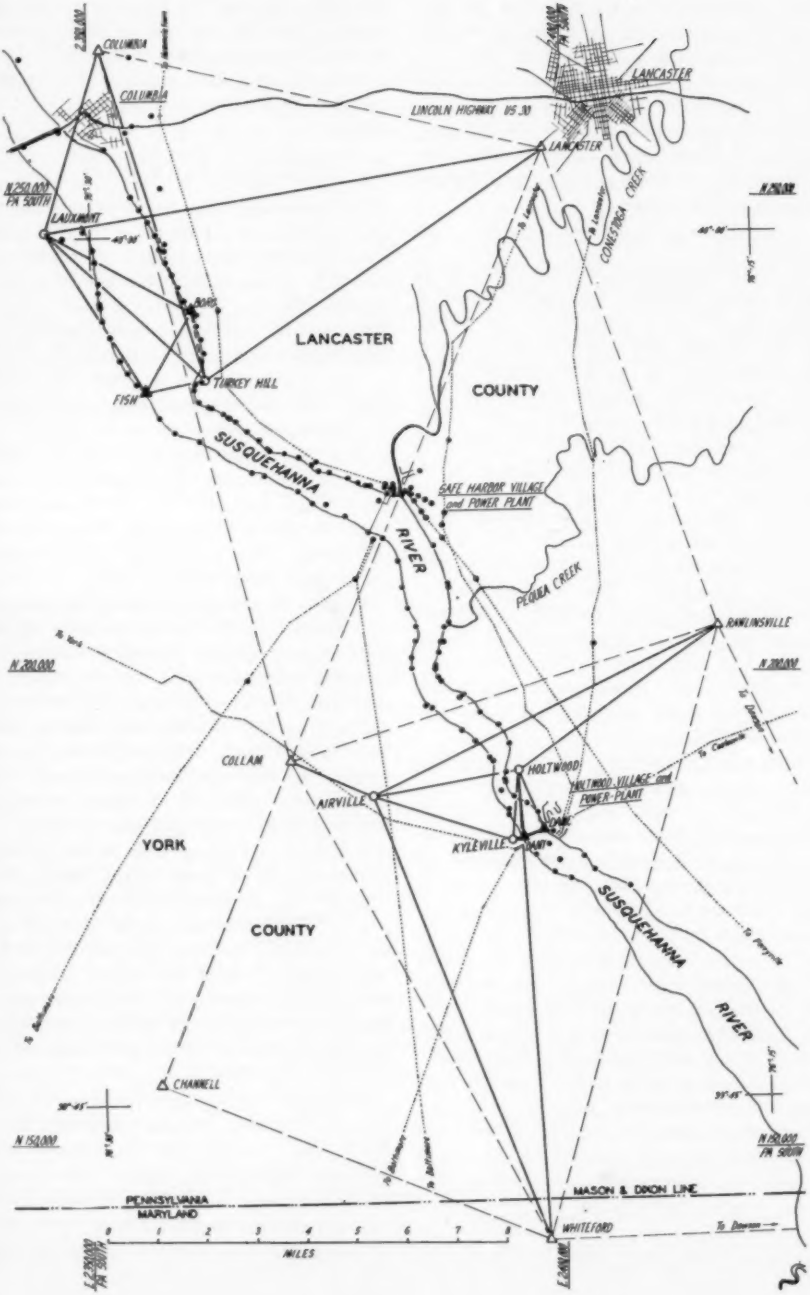
During the time that these maps were lost, another surveyor was engaged by the successor company to map the river from a point somewhat upstream from the Holtwood Dam to above the Columbia Bridge. The original copy beautifully done in color shows the triangulation used to control most of the work, but none of the stations



Transmission towers may be effectively used for control survey stations. They may be occupied as ground stations, and, except for seasonal crops, are on a cleared right-of-way. Distant towers serve as azimuth marks. The tower itself is a permanent signal with high visibility. Towers are clearly designated by serial numbers stenciled on the legs and so are easily identified in the field. Such stations have the advantage of permanency. No climbing on the towers should be permitted except when accompanied by authorized personnel or company representatives. Any damage to growing crops should be avoided and, if necessary, agreement as to settlement should be reached in advance with the farmer even though he may be cultivating company owned right-of-way. When using the tower as a signal, it is better to take two sights on symmetrically opposite points, such as the ground-wire supports indicated by arrows, rather than try to select the tower with the vertical cross-hair.

⇒

The location map on the opposite page illustrates how the effectiveness of the first-order control of the U. S. Coast and Geodetic Survey (open triangles) was extended by five supplementary stations (open circles) to include four stations (solid triangles) of a company triangulation system. By means of these connections, the local coordinates of the other stations of the company net (solid circles) may be converted as and when needed to State grid coordinates. These stations have already served to control surveys of the Pennsylvania Water & Power Co. and the Safe Harbor Water Power Corp., including extensive underwater surveys of coal-bearing silt deposits, construction projects, and hundreds of parcels of real estate, the corners of which are monumented. Coordination of the more prominent towers along the transmission lines (dotted lines) offers a practical means of extending the advantages of coordinated surveys referenced to the State system.


COLUMBIA
COLUMBIA
LANCASTER
LANCASTER
LINCOLN HIGHWAY US 30
LAUDERMAN
CONESTOGA CREEK
LANCASTER
COUNTY
TURKEY HILL
FISH
SUSQUEHANNA
RIVER
SAFE HARBOR VILLAGE and POWER PLANT
PEQUEA CREEK
RAWLINSVILLE
COLLAM
HOLTWOOD
HOLTWOOD VILLAGE and POWER PLANT
AIRVILLE
KYLEVILLE
YORK
COUNTY
SUSQUEHANNA
RIVER
CHANNELL
PENNSYLVANIA
MARYLAND
MASON & DIXON LINE
WHITEFORD
MILES
0 1 2 3 4 5 6 7 8

were permanently marked on the ground. The map contains no notation as to the origin of the grid, the location of the meridian which coincides with the true geographic north, or whether any cognizance had been taken at all of the convergence of the meridians. Furthermore, no thought had apparently been given to the production of working prints.

PROFIT BY PAST EXPERIENCE

A third beginning was made as late as 1924. The engineer in charge of field parties happened to have been a transitman on the second survey and so appreciated the limitations of the former work. He took care that all stations were permanently marked with copper plugs set in solid rock, carefully described with respect to distances to nearby objects. Although many of these have since been submerged by the creation of Lake Clarke back of Safe Harbor Dam, enough of the original stations still remain so that new stations can be established to replace those lost. The location of the Polaris observation from which the orientation of the grid was determined was clearly shown and allowance was made for convergence of the meridians between this station and those occupied for other astronomic observations.

While it would have been desirable to have had the grid for the third survey coincide exactly with that of the second, unfortunately there was no record of the coordinates of any of the control points of the second survey. Fortunately, however, this engineer remembered that three stations which he had occupied as transitman on the second survey were so restricted as to possible set-up that once he identified the general locations of them he could reestablish new stations very close to where the previous ones had been. The coordinates according to the system formerly used had to be scaled from the map, but when it was found that the distances determined from them checked closely with the newly triangulated distances between these stations, it was believed that the grid finally adopted agreed with the old as closely as could be plotted at a scale of 300 feet to the inch. In this way the new work could be blended with the old as each part of the river was successively resurveyed. Thus it was not necessary to scrap the second survey entirely, but rather to revise it piecemeal.

POWER PLANT LOCATION

The immediate purpose of the new survey was to obtain a topographic map in sufficient detail for the selection of the site for the then proposed Safe Harbor Dam and Power Plant. To provide for possible range in site location, it was necessary to cover about 1½ miles of the river, which at that point was about 4,000 feet wide. Later the control triangulation network was extended upstream to the Columbia Bridge and downstream to a point about 1½ miles below the Holtwood Dam. The control net included five measured base lines, the greatest discrepancy between any two being 1 part in 18,000. The other checks were considerably better.

Besides the general objective of serving as a framework for the survey as a whole, the first unexpected benefit of the triangulation was realized when a traverse had been run across the river bottom to a station on the tow path of the old Susquehanna and Tidewater Canal. When plotted, it was found that this line extended exactly one tape length beyond the towpath according to the second survey. Of course, there was the usual conclusion that some careless chainman had dropped a tape length. The traverse was rechecked, but with the same result. Triangulation proved the traverse to be correct and then it was discovered that in this locality the second map had been merely copied from a previous erroneous survey without any indication of what parts were original survey and what others had been "cribbed."

It was, of course, a disappointment to find that the river was actually 100 feet wider than shown on the map on which a preliminary engineering report had already been based, but at that the disappointment was not as great as it would have been had we used the only other topographic map

available. This map was one of the earliest U. S. Geological Survey quadrangles controlled only by a single peripheral traverse and within which an accumulated error of 400 feet had been disposed of in the river. Considering the difficulties of surveying heavily wooded steep slopes by planetable in the early days, and the relatively little importance of the shoreline of that bank of the river after the Susquehanna Canal had been abandoned, it is little wonder that a mistake of this kind should occur. We are glad that aerial photography and modern methods of photogrammetry have now made mistakes of such magnitude things of the past.

After the consulting geologist assured us that satisfactory foundation could be found anywhere in the reach of the river in which we desired to locate the plant, the selection of the site for the new dam depended almost entirely on the topography of the river in relation to computed backwater from the Holtwood plant below. Consequently it was desirable to have a comprehensive survey of all sites to be considered; however, time and manpower were at a premium, so the field parties were concentrated at the more critical locations, leaving gaps of lesser importance but, nevertheless, gaps which should be filled in for the sake of completeness. To supply this lack, much additional material was taken from cross sections previously made by the U. S. Engineers and also from the two earlier surveys. One additional and valuable source was a map handed down from the old canal company giving in considerable detail the plan of the canal and towpath as constructed. It is interesting to note that because of a well established base, surveys made as much as 80 years apart could be incorporated into one coordinated map.

After the dam site had been selected from the map, it could be accurately located in the field, because all the control points had been carefully monumented. This would not have been possible if the engineer in charge had not foreseen the need for something better than a "rough map just for estimating purposes."

PROPERTY SURVEYS

The problem of determining which properties are necessary for a large hydroelectric project, of accurately locating the many purchases and monumenting their bounds, as well as defining the "project boundary" for the purpose of a Federal license is a tremendous task, particularly as the old deed descriptions frequently prove to be far from accurate. There is the constant danger of overlooking some small property, and considerable confusion may arise from gaps and overlaps. To meet the problem of knowing exactly what property had been bought, and accounting for all the land within the project limits, it is almost necessary and certainly advisable to have coordinated maps. This need was early seen by our real-estate agent, Rowland L. Bortner, now Vice President, who appreciated the advantage of tying to the established triangulation control net all property surveys along the river. This has proved very satisfactory and an excellent investment in community and neighbor relations.

HYDROGRAPHIC SURVEYS

Not only on land, but also on water has the established control proved of material benefit. The decision to build a $13,000,000 addition to the Holtwood Steam Plant depended on underwater surveys to determine whether coal residues from the washings at the anthracite collieries were still finding their way downstream in spite of efforts to check further contamination of the stream at the source. This fuel, otherwise wasted, accumulates in the slack water behind our dams and the question was whether the rate of accretion was sufficient to justify materially increasing the steam-generating capacity of the existing Holtwood Steam Plant. Not only have the survey ranges been tied to the company control grid, but in special surveys the positions of the sounding boat have been determined sometimes by three-point fixes on targets. These special surveys have verified the accuracy of the surveys made in the customary way by running ranges.

COAST AND GEODETIC SURVEY CONTROL TIE

In 1935 the Coast and Geodetic Survey, while extending its basic triangulation network along the Susquehanna Arc, established two supplemental stations for the purpose of making a connection with two stations of our local net. The original intention was to make a "line check" by comparing the C&GS determinations of length and azimuth with ours. The two measurements agreed so closely that the question of making or not making a sea-level correction for only 225 feet of elevation would have changed the sign of the difference from plus to minus. Nevertheless, it was decided to wait for a possible second connection near the southern end of the net. In 1947 this second connection was completed in conjunction with other work of the Coast and Geodetic Survey, and the two ties formed, in effect, a line check some 12 miles long It was the opinion of the Coast and Geodetic Survey that our local coordinates could be converted directly to Pennsylvania South Grid Coordinates accurately enough for cadastral purposes. Should the need arise, we are now able to convert any of our coordinated survey points, as well as the bounds of several hundred separate parcels of real estate, to the authorized State Plane Coordinate System.

This means that we are in a position, whenever there should be sufficient local interest and appreciation of the value of State plane coordinates, to assist local surveyors materially in taking advantage of this system. There are undoubtedly many locations where it would be practicable for our neighbors to tie their properties to our established monuments and thus obtain the common benefit of permanence in deed descriptions.

CONVERSION TO STATE PLANE COORDINATES

The ability to convert company local coordinates to State plane coordinates, and vice versa, found practical application soon after it was approved by the Coast and Geodetic Survey. It was in our interest to supply an aerial-survey contractor just as much control as possible for about 30 miles of new transmission line extending from Safe Harbor to Hummelstown, Pa. Along the greater part of this line the geographic positions of a fair number of control points were available, and those could readily be converted in the conventional manner to the State coordinates. Therefore, the contractor decided to make the entire survey based upon this system. At the beginning of the line near Safe Harbor, we had extensive real-estate surveys all based upon the company grid which had been in use for a number of years before the adoption of the State system. For our purpose it was desirable to retain this system in the territory where we had already done a considerable amount of surveying, at least until the State system had become generally accepted. However, to ask the aerial-survey company to break its work into two different sections, each on a different grid, would be an imposition, and add needless confusion. However, the interchangeability from one system to the other proved the happy solution, for it permitted the use of a large number of additional control stations and picture points that we could furnish. We simply decided on a well-defined junction point and continued to use our coordinates for the few miles between this point and the plant; beyond we both used State coordinates. The ability to reduce all the necessary basic data to either system greatly strengthened the horizontal control for the aerial survey, but it would not have been possible to do this if those in charge of the field work 27 years before had not foreseen the need for maintenance of high standards of accomplishment.

We can now see clearly that, in the rush of a construction program, particularly in the early stages of a project when financing is a problem, there may be an incentive to do no more in surveying, monumenting, recording, and so on, than may seem necessary for the immediate purposes. Consequently, we are indebted to H. C. Kern for the conscientious work in the field and his personal effort in maintaining the quality and reliability of the company's surveys made under his direction.

ADVANTAGES OF STATE COORDINATES

Our first experience in the use of State coordinates led us to appreciate the advantage of not having to make any correction for the convergence of the meridians. On previous transmission-line surveys it had been necessary to adjust the bearings of the courses to geographic directions as the work progressed. When a line runs nearly east and west, this is particularly annoying, for in our latitude it requires an adjustment of about 2 minutes in every 3 miles, and so affects the observed angles and bearings of adjacent courses. The use of State coordinates eliminated all this complication in the recent survey from Safe Harbor to Hummelstown, Pa. In the entire line we have only one measured angle that does not agree with the difference between the bearings of the courses, that being at the junction where, as before mentioned, the shift is made from State to local coordinates.

Furthermore, this means that along about 80 percent of the line the descriptions in the deeds for the property acquired are all given in State grid bearings so that when there should be general application of State coordinates, the bearings will not need to be converted. When the survey as a whole is adjusted between control points, we shall be in an excellent position to supply coordinates for all corners of the land held. Thus, whenever the county or other authorities decide to make accurate tax maps, they will have at least a backbone of 30 miles of property accurately located.

VERTICAL CONTROL

So far I have considered only horizontal-control surveys. We have likewise had both good and bad experience in the vertical dimension. Our company inherited from its predecessor an agreement which afterwards led to a great deal of costly litigation, much of the dispute arising from poorly defined elevations. In an attempt to be more specific, some lawyer who apparently didn't know much about surveying, added the phrase, above mean low water at such and such a place as defined by the bench marks of such and such a railroad. This railroad had never at any time used a datum referred to mean low water at any place, but rather to mean sea level at Sandy Hook, and only a very few tidal observations, far too few to define a datum plane, had ever been taken at the point specified. The result was that a margin of safety had to be allowed for the unknown relationship between what might have been determined to be mean low water and the datum actually used by the railroad.

On the pleasant side of the picture the U. S. Geological Survey, at the request of the party with which we had an agreement as to permissible back-water effect, ran a line of precise levels to establish an accurate relationship between the levels at our plant and at that party's project 15 miles below. Fortunately our field engineer met the chief of party, incidentally a former chairman of the Control Surveys Division of ACSM, while he was running this line. Our man pointed out the bench marks that we had established and, as far as possible, the USGS utilized them. Therefore, we had the benefit of verification of the work of our engineers using ordinary levels by a USGS party using the latest refined methods. We appreciate R. M. Wilson's personal interest in this line of levels.

That was not all, for we found the U. S. Geological Survey extremely cooperative. They assisted us in making a general adjustment, combining their work with ours, of a line of levels about 20 miles long on one bank of the river, together with a loop around the perimeter of what was subsequently to become Lake Clarke, or the Safe Harbor pond. This adjustment, in which each run with precise level was considered equivalent to five of our runs with engineer's level, closed so satisfactorily that the Geological Survey joined us in a request to the Coast and Geodetic Survey that, when this line should be finally adjusted into the general network and reduced to sea level datum of 1929, all our bench marks should be raised or lowered by a constant amount. In other words, this line had been so carefully checked and the loop

found to agree so accurately that we had the best assurance that all our bench marks, on which back-water agreements with property owners would depend, were in agreement with a common datum and no dispute in the future might arise from the fact that subsequent adjustment might show discrepancies. It is interesting to note that throughout the years recording gages have been operated at three power plants, there has been no indication of doubt as to the accuracy of the levels by which the gages were set.

VALUE OF MANUSCRIPT MAPS

It is said that the saddest words that have ever been written are these, "It might have been." Possibly it is fortunate that we don't always have just what we want, because only in this way do we appreciate what we have. In connection with this transmission line to Hummelstown, it is estimated that we could have saved at least $5,000 if large-scale manuscript maps of that area had been available, such as were made during the war for the area nearer Washington.

I know of one case where access to these manuscript maps has actually meant a large saving to one of our customers. This company has to draw maps showing details of their distribution system, including the individual poles, transformers, and even house connections. Some of these are at a scale of 400 feet to the inch, others are at 200 feet to the inch, and still others for the urban areas are at 100 feet to the inch. These maps must match at their borders, otherwise there is considerable confusion. Under these circumstances the value of a controlled base map showing accurately the relation between all parts of the territory to be covered will be well appreciated. All this, of course, proved to be an unexpected by-product of just an ordinary mapping project undertaken by a Government agency. Unfortunately business does not always have the vision to realize that "unexpected" benefit is to be expected in one form or another. There should be more appreciation of the work of Federal mapping agencies and the many ways in which industry may be served.

COOPERATION

Looking back over the history of our organization it is impressive to consider the great amount of give and take in our relations with others. We have attempted to hold up our end when it came to giving, but we have certainly received a large return on this investment. All this confirms one's belief in the fertility of free exchange of ideas and demonstrates the creative efficiency of wholesome cooperation.

In the matter of surveys and mapping we have been particularly grateful to the Coast and Geodetic Survey and the Geological Survey, for both have always shown an extremely cooperative attitude. At times this assistance takes unusual forms. For example, a hint contained in a brief note published in the Journal of the Coast and Geodetic Survey gave us the idea of how to check our fathometer under actual operating conditions. Inasmuch as the surveys formed the basis for a $13,000,000 investment, it is easy to appreciate the value of anything that would confirm the reliability of the results.

The aid from the Coast and Geodetic Survey did not end here for, in addition to a number of hints which led to more effective use of the fathometer itself, an incidental call on Captain Hemple resulted in our engineer in charge of the measurement of depths by echo sounding meeting Commander Burmister with results very advantageous for us. The Coast and Geodetic Survey subsequently gave material aid in equipping a new and more efficient survey boat for use in continuing surveys of the river. We have also had frequent occasion to call upon the services of the Office of Map Information of the U. S. Geological Survey and have found J. O. Kilmartin extremely helpful. On occasion our men were badly handicapped by not having the most recent maps of territory in which they were working. A telephone call to Mr. Kilmartin soon had the needed maps on the way.

OTHER PUBLIC AGENCIES

The company has endeavored to encour-

age extension at State level of the work done by National agencies and has watched with much interest the progress now being made by the Maryland Bureau of Control Surveys and Maps with George W. Cassell, engineer in charge.

During the 14 years since the passage of the enabling act recognizing the legality of Maryland State Plane Coordinates, the company has seen many examples demonstrating clearly the need for such an office, where all those having problems in control surveys or desiring information concerning available maps can freely obtain advice and assistance. There are numerous instances where private surveyors and industries as well have consulted us in the interim when the war interrupted the activities of the former bureau and before the Advisory Committee headed by Dean S. S. Steinberg of the University of Maryland could reestablish it on a more businesslike basis. It is our belief that this office can prove to be a very useful adjunct to the Federal agencies, thus providing a better means of bringing about a more perfect liaison between those charged with the establishment of fundamental control and the users of the survey data. We believe that it would be very much to the advantage of industry to give wholehearted support to similar efforts that are being made in other States.

EXPERIENCE OF INDUSTRY AS A WHOLE

Having reviewed some of the experiences of our own organization, it seems appropriate to ask if this has been typical of industry as a whole, or if fate has been unusually kind to us. I regret that it is my opinion that industry as a whole has not taken full advantage of the many opportunities for economy that well-ordered surveying programs offer. On the other hand, I believe that our experience has been indicative, not of things that will come about of their own accord, but rather of things which can be brought about through one's own effort, care, and foresight.

WHAT SHOULD BE DONE

To obtain fuller utilization of the many possibilities before us will require enlightened cooperation of the part of many organizations and a great deal of mutual understanding, such as the American Congress on Surveying and Mapping can foster. There should first be a more widespread appreciation of surveying and mapping as a field of common interest where ultimate economies can be effected and where the foundations may be laid for greater accomplishment.

In our contacts with Federal mapping agencies we have witnessed a growing inclination of willingness to raise their sights above the task of surveying for the sake of mapping alone. Their policies can readily be shaped to meet the needs of industry and such is certainly to be encouraged, because industry through the part it plays in our national economy in turn passes these benefits on to the citizens. The government agencies should have no fear that their good works are being improperly diverted to enriching private pockets at government expense.

Industry in turn must envision its own needs and opportunities, and realize that the surveys of private corporations can assist greatly in expanding the vast network of control data needed by government agencies to serve the country in peace and in war.

The Federal government should extend its services by fostering the establishment and encouraging the growth of State, county, and municipal units working in close liaison with Washington, but with offices advantageously placed to reach industry locally instead of by long-distance contact. Industry on its own part should seek to cooperate with such bureaus and, particularly in the formative periods, to nurture and assist them in overcoming the initial indifference they are bound to encounter. The engineering staffs of many corporations can do well to give the matter serious consideration in the confident expectation that benefits will quickly and surely accrue which will more than repay their efforts.

Business executives should regard well-considered surveying and mapping a worthwhile investment and not merely an un-

avoidable present outlay to be trimmed to the minimum. There is need for a better understanding of the proper sequence of steps, beginning with the basic accurate framework to which details may be added *ad infinitum*, rather than first a sketch, then something a little better, and finally complete revision back to the beginning.

I believe that our colleges and technical schools would do well to reappraise their attitude toward the teaching of surveying. If industry is to use its civil engineering staffs to the fullest advantage it is necessary to have personnel who look beyond the mere technique of performing routine operations and who can appreciate the broader aspects of surveying as a field in which the best of human ingenuity can be used advantageously.

The practicing property surveyors need to revise their attitude and cease to fear that coordinated surveys referred to a standard or accepted grid will reveal errors which the surveyor might wish to have remain hidden. The mutual strength that one survey gives to another when tied together, the ability to isolate and run down accidental errors, which readily become very costly, are the obvious rewards of coordination. Industry is already spending considerable sums of money maintaining its own engineering staffs; it is obvious that simply to make this effort more effective would mean an important saving. This is possible if industry is willing to cooperate.

As to public utilities, it would seem that the regulatory commissions should encourage prudent investment in such surveys as will enable companies to operate with regard to the highest interest of their territories. The utilities themselves should feel their responsibility to the citizens within their service areas. Such companies do take pride in contributing in many ways to the general well being and recognize the importance of good public relations. Well-considered surveying and the establishment of control data useful to the countryside, of course, may not have the same type of appeal as many other activities in which companies do engage, but they nevertheless do present opportunities for worth-while building of substantial good will.

STATE PLANE COORDINATES

We are all aware of the inadequacy of our present system of recording of land and also of the growing complication and danger of conflict over lost bounds and imperfect deed descriptions. Experience has shown that, in spite of some difficulties still to be overcome, the solution lies in the coordination of surveys to a common base. These bases have been established and in more than half of the States in the Union they have been adopted by act of State legislature. On the other hand application has been discouragingly slow, mainly for the reason that as yet we are far from having a sufficient density of control points. Ordinarily Smith and Brown individually cannot be expected to pay the high additional cost of running the connecting surveys that at present are necessary to bring the established control to their properties. Thus the system so far has bogged down.

The need is not to bring the control to individual parcels as they happen to require coordinated descriptions, but to approach the problem in a more methodical manner by extending the control as opportunity presents itself. It is to the advantage of large industries as well as public utilities to have their own properties accurately and carefully defined, well monumented, and described in unequivocal terms. In accomplishing this they can automatically bring accurate control data within reach of their abutters, and thus start the expansion of wide-range coverage. Any work of this kind should, of course, be cleared through a central agency, such as the bureaus of plans and surveys in progressive cities, counties, or States, but material assistance in a joint effort can well be supplied by the engineering organization of these industries.

What is expected in return? The answer is simply that in checking the rising cost of land disputes and in facilitating the salability of real estate, to the extent that less effort is wasted on predatory wrangling, just so much more effort can be given to eco-

nomic progress, better life, and better business. If the term "better business" should offend, let us say "better civilization."

TEST AREA

To examine the soundness of this suggestion, we might select a proving ground where conditions are favorable for testing the practicability of the use of State plane coordinates in rural areas, in contrast to cities where the need for coordinates is already well recognized. In addition to our company's network of triangulation extending for 20 miles along the shores of the Susquehanna River, we have recently completed 30 miles of transmission line, the survey for which was tied to C&GS triangulation stations. In the course of this survey some 20 or more new intersection points were tied in and, judging by the attitude previously shown, the Coast and Geodetic Survey would be willing to verify our computations and certify as to the quality of the work and the accuracy of these new positions. With some additional observations on our part, combined with our existing property surveys, it would be possible to supply for public use the coordinates of the most prominent of the 150 transmission towers, if not all of them. With such density of control a local surveyor would have litttle difficulty in determining the coordinates of some point or points for most property surveys within an area, say, 40 miles long and 2 miles wide, either by direct tie or by the use of the three-point solution confirmed by at least one additional pointing.

Technically the stage is set. From the human point of view this territory is inhabited by a characteristically "land-loving" people, noted for their husbandry and regard for the soil cultivated by their fathers for generations. It would seem that whatever would give permanence to their boundaries and protect against the ravages of time would strongly appeal to them.

So far the weak link seems to be lack of appreciation and understanding of these possibilities. Here is the challenge to you. Can the Property Surveys Division of ACSM do anything to get things started? This does not concern merely some 80 square miles, for it is a test of practicability, an opportunity to learn the weaknesses to be corrected and to gain experience which can be expected to have considerable bearing in accelerating similar progress throughout the entire country.

INDUSTRY'S STAKE

Industry has a far larger stake in surveying and mapping than is commonly appreciated. I believe that our organization is in a position to know this, as we have both suffered from bad experience and profited by good. There are great possibilities ahead, and we may expect the American Congress on Surveying and Mapping to carry the torch of enlightenment. Let the world know that you are not so absorbed in the technique of surveying for the sake of maps alone that you do not look to the larger aspects of what your efforts can bring to all.

Refresher Courses Offered

SEPARATE refresher courses in land surveying and general civil engineering were started on October 19 by the University of Virginia Extension Division. The six-week surveying course, geared toward the State registration examination, consisted of 12 two-hour classes covering computing, use of calculators, topography, and interpretation of property description. All classes are held at the Northern Virginia University Center, 1312 N. Quincy St., Arlington, Va.

Present plans call for similar courses to be given in February 1954 in preparation for the May State examination.

Surveying Education and the Federal Agencies

By MILTON O. SCHMIDT
PROFESSOR OF CIVIL ENGINEERING,
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THE BEGINNINGS of surveying instruction in the American engineering schools are contemporary with the Western surveys of exploration that led to the creation of the U. S. Geological Survey in 1879. One of the most significant influences affecting the design of civil engineering curricula for several decades was the steady demand for surveyors by the railroads in their golden era of expansion from 1880 to 1900. This development, together with the surveying requirements of countless other activities that can be associated with the rapid growth of our country, kept the very practical role of surveying in sharp focus for many years.

It is understandable, therefore, why surveying constituted no small part of the early curricula in civil engineering. A large percentage of the graduates entered upon employment requiring an adequate knowledge of this subject. However, following several decades of intensive instructional programs in surveying, there took place a progressive decrease in the scope of such training in order to meet the needs of new subjects within the framework of the same 4-year curriculum. Condensation and elimination of the older surveying courses was an inevitable educational metamorphosis. We are not concerned with those changes that have merely decreased the number of topics to be studied. We are troubled, however, by a secondary effect that accompanies severe abbreviation. This is an impairment of the quality of surveying instruction. No engineering teacher with professional ambition will willingly permit himself to be confined to instruction dealing exclusively with elemental surveying principles and shop exercises.

Presented at the Thirteenth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., March 23–25, 1953.

This trend, when considered in the light of current accelerated demands for high-quality surveys and comprehensive maps by the Nation, has led to a situation in which surveying instruction has not kept pace with recent developments in the art nor with the ever-widening vistas offered by the broadest understandings of the science. This, in turn, has adversely affected the availability of young graduate civil engineers for positions in the Federal surveying and mapping programs. The role of the Federal agencies in promoting surveying and mapping education has never been adequately recognized. The need for survey data and maps lends renewed emphasis, therefore, to the necessity for closer liaison between the Federal surveying agencies and the schools.

MAPS AND RESOURCE DEVELOPMENT

Topographic mapping and the expansion of the horizontal and vertical control systems are inherently functions of the Federal government since they are prerequisites for the economic development of the Nation and for its protection in the event of armed conflict. In peacetime the wisest use of our natural resources—water, minerals, timber, and land—depends, first of all, upon careful inventorying of these resources and frequently their portrayal on a sound map base. In the area of water resources development, for example, it has been constantly reiterated that the solution of the problem, whether it be related to navigation, hydro-electric power, or flood control, is dependent, in part, upon comprehensive topographic data. The recent reports of the President's Water Resources Policy Commission and of the Water Policy Panel of Engineers Joint Council document these needs for fundamental physical data if national and regional planning is to be based upon facts.

Present plans hopefully contemplate the completion of the topographic atlas of the United States in a 20-year period and the execution of the necessary control surveys in a shorter period in order to satisfy the Nation's requirements for general-purpose maps. This objective and the acute need for special military maps emphasize the long range personnel requirements of the Nation's cadastral mapping, control surveys, and stream-gaging programs. National development is aided by the effective employment of well-trained civil engineers in these surveying and mapping activities. On the other hand, basic resource studies are retarded if college and university training lacks the fiber and luster needed to stimulate professional interest in this area, and if the Federal and similar surveying agencies fail both to maintain good public relations with the engineering schools and to offer the promise of professional prestige to potential employees.

The Nation's programs of resource development and military defense depend in no small measure, therefore, upon securing the services of those who have had training in surveying and mapping. Despite the hurried treatment of these subjects in all civil engineering curricula, civil engineers are generally better informed as to the requirements of the Nation for survey data and topographic maps than any other professional group. Although the need for the establishment of a 4-year program in surveying and mapping at some one American university is a real one, until that need is translated into action, civil engineers are still best qualified to organize, administer, and prosecute the comprehensive mapping and surveying programs. Only those with broad training in civil engineering can be competent to appraise the total mapping situation and its relation to national planning and the practice of engineering.

SURVEYING INSTRUCTION

Some two decades ago surveying and mapping encountered the first serious competition for time and space in the educational programs with new and expanded courses in other areas of civil engineering. It is not nearly so regrettable that surveying instruction has been cut down to a size as that it is still frequently a tiresome recital of techniques and procedures that fail to awaken any measure of professional purposefulness.

Preoccupation with routine procedures requiring only a modest amount of mental equipment has been a lamentable characteristic of surveying teaching. Also, course work has been highly compartmentalized. A chapter on astronomy is set off by itself, studied, and then the container is sealed as if in evidence that another fund of knowledge has been effectively assimilated. Instruction by the project or case method in order to demonstrate the structure of the entire surveying problem, whether it be in topographic mapping, nautical charting, or similar activities, presents a challenging subject for educational exploration.

Surveying instruction has frequently been associated with a multitude of such topics as the adjustment of instruments and short cuts or special techniques to be used under unusual circumstances—to the exclusion of what is much more important. I refer to that broad grounding or education as to the utilization of maps and survey data in the later professional life of the civil engineer. Without it, surveying instruction is shallow and uninspiring. For example, we have graduate civil engineers who can recall, although perhaps with indifference, how to test a level but who have been poorly informed as to the availability of maps and survey data, are ignorant of the cooperative programs in control surveys and topographic mapping, and have an inadequate appreciation of the role of such basic data in resource development and planning at all levels of governmental organization. It is logical to conclude that just as good topographic data is necessary for economic development, quality instruction in surveying and mapping is an indispensable prerequisite for awakening the interest of tomorrow's civil engineers in the Nation's mapping programs. Wider knowledge of the availability of survey data and maps and deeper understanding of their usefulness will result from such improved instruction.

FEDERAL SURVEYING AGENCIES

The Federal agencies and the schools of civil engineering have a mutual interest in re-establishing the integrity of surveying instruction in America. The teaching staffs of our technical colleges and schools represent an important segment of the engineering profession and their products are the engineers of tomorrow. It is easy to depreciate the young entering freshman but in four years he represents a source of technologic man-power even though raw and unlearned.

Both the Federal agencies and the schools of civil engineering have a dual responsibility in promoting the execution of adequate programs in basic engineering surveys and topographic mapping in the U. S. The role played by the educational institutions is patently that of training young men in the several areas embraced by the curricula in civil engineering, educating them for careers of true professional endeavor, and, perhaps, impersonally assisting them in appraising the market for their engineering services. Although the Federal surveying and mapping agencies are ostensibly interested in young civil engineering graduates because they are potential candidates for employment, these organizations must make a more concerted bid for them if civil engineers are to continue to direct and execute surveying and mapping programs. It appears, then, that the Nation's program in resource development, aided as it is by government control surveys and topographic maps, is further strengthened by the development of better liaison between the

Bill M. Woods (*left*), Map Librarian of the University of Illinois Library, discussing a map problem with geographers (and ACSM members) J. A. Russell, A. W. Booth, and F. W. Foster of the University staff. The University of Illinois map collection includes 145,000 maps, 3,000 books and atlases, and 18,500 aerial photographs. This map collection was organized to meet the requirements of the students and faculty, and includes practically all maps published by Federal and State agencies. Through these facilities, students and faculty are made familiar with the availability and use of the map products of Federal agencies. (*Photo by Illinois Alumni News.*)

Federal agencies and the schools. This does not imply that the mapping organizations do not express a strong interest in the educational institutions. The cooperation of the agencies in furnishing literature for classes, speakers for conferences, and providing technical assistance has been very gratifying. However, more of the cooperative effort should be initiated by the U. S. Geological Survey, the U. S. Coast and Geodetic Survey, and other bureaus. It should be planned, continuous, and long range in character. Such contacts with the schools should possess the convincing qualities and the warmth that a U. S. Civil Service Standard Form 57 (application for employment) lacks.

It is suggested that the agencies embark upon a studied program of public relations with the colleges in order to make the teachers better informed of opportunities in the Federal service and to stimulate the interest of prospective graduates in the surveying and mapping programs. We cannot deprecate too much the shortsighted vision of the professional engineers who are not enthused about the use of Statewide plane coordinates and other similar developments of the art when it is considered that the personnel requirements of an accelerated and long-range program of basic surveys may not always be given the thorough attention they deserve. Consider the equipment manufacturers who are displaying their products here. They are thinking not so much of today's sales but of the need to cultivate and maintain an attitude of interest in tomorrow's equipment on the part of all prospective users. It is a continuing task to keep the prospective purchaser interested in the best that the firm has to offer.

PUBLIC RELATIONS

A program of public relations with the schools might include conferences with teachers, the support of educational symposia, the establishment of a plan similar to that of a well-known chemical firm to provide "A Year-in-Industry" for engineering educators, and increased opportunities for summer employment for young instructors. In this connection, no regional public relations office should constitute a sinecure for a mature employee about to be retired.

We in education have not always realized our responsibility to become informed through continued self-study of the developments in surveying and mapping, we have been derelict in emphasizing the role of the Federal agencies in our country's resource planning, and all too often we have placed the inexperienced teacher in charge of surveying instruction.

The quality of surveying and mapping instruction depends not so much upon the amount of time devoted to it or upon the intrinsic soundness of the textbook as upon the sinews which it develops under capable teaching services. The progress of our national mapping and surveying programs can become impeded not only by budget retrenchments but also by the inability to secure the services of needed engineering personnel. The development of a widespread, aggressive, and intelligently directed program of public relations with the engineering schools will aid not only surveying education but also the Federal agencies themselves and ultimately the Nation.

Plan to Attend

The Fourteenth Annual Meeting

MARCH 22, 23, 24, 1954

Shoreham Hotel, Washington, D. C.

The Concept of a Bay as Inland Waters

By A. L. SHALOWITZ
UNITED STATES COAST AND GEODETIC SURVEY

RECENT DEVELOPMENTS in the study of the seaward boundaries of the United States and the seaward boundaries of inland waters, make it desirable to amplify the discussion of this subject contained in the article by the writer on "Cartography in the Submerged Lands Oil Cases," published in the July–September 1951 issue of SURVEYING AND MAPPING. Brief mention was made there of a technical method for determining the status of a coastal indentation—that is, whether inland waters or open sea—and its relation to the submerged lands cases. Since publication of the article, references have been made to the method which reveal a serious misunderstanding of its application to a coastline. The purpose of the present article is to amplify and clarify the method, with particular emphasis on its origin and the reason for its development.

Recent legislation passed by the Congress,[1] confirming and establishing in the several States titles to the submerged lands within their historic boundaries and providing for Federal control and jurisdiction of the submerged lands beyond such boundaries, emphasizes more than ever the need for establishing judicial criteria by which the status of an indentation can be ascertained, and in turn the seaward limits of inland waters, in order to determine with some measure of consistency the seaward boundaries of the States.

THE NORTH ATLANTIC FISHERIES ARBITRATION OF 1910

The genesis of the method goes back to the North Atlantic Fisheries Arbitration of 1910. The arbitration and the subsequent treaty of ratification marked the culmination of a century-long dispute between Great Britain and this country growing out of the Treaty of 1818, in which the United States renounced the right of its nationals to fish within "three marine miles of any of the coasts, bays, creeks, or harbors" of the British dominions in America. Great Britain interpreted the treaty provision to exclude American fishermen from all bays, regardless of size, contending that the limit described in the treaty should be measured from the headland-to-headland line. The United States took the position that only bays not more than 6 miles wide at the entrance should be excluded.

After an elaborate presentation by both contending parties, the Permanent Court of Arbitration at The Hague rejected the United States position and made the following Award:

> In case of bays, the three marine miles are to be measured from a straight line drawn across the body of water at the place where it ceases to have the configuration and characteristics of a bay. At all other places the three marine miles are to be measured following the sinuosities of the coast.

The Tribunal realized that the decision, though correct in principle, and in its opinion "the only one possible in view of the want of a sufficient basis for a more concrete answer," was not entirely satisfactory as to its practical applicability. It therefore adjoined to the decision, as it was empowered to do under the special agreement, the following recommendation:

> In every bay not hereinafter specifically provided for, the limits of exclusion shall be drawn three miles seaward from a straight line across the bay in the part nearest the entrance at the first point where the width does not exceed ten miles.

The 10-mile rule was incorporated in the Treaty of 1912 between the two countries. For the United States, it represented a recession from its position that inland waters

[1] Public Law No. 31, approved May 22, 1953, and Public Law No. 212, approved August 7, 1953.

were limited by the 3-mile marginal belt rule to bays 6 miles wide, but it was accepted as a proper limitation upon the sweeping headland-to-headland doctrine advocated by Great Britain.

The net effect of the Tribunal's recommendation was to limit inland waters to a 10-mile distance where the indentation is wider than 10 miles at the entrance. There was no provision as to the nature of the indentation other than that contained in the Award regarding the "configuration and characteristics of a bay." This left unsettled the important question as to the kind of indentations that possess the configurations and characteristics to bring them into the category of inland waters over which a nation could exercise exclusive jurisdiction. This remained for future technicians to grapple with.

THE HAGUE CONFERENCE OF 1930

An attempt to arrive at a geometric solution to the problem of the status of a bay was made in 1930 when The Hague Conference for the Codification of International Law was convened. From preliminary questionnaires, it was understood that most delegations were willing to go along with the 10-mile rule provided some method could be worked out whereby small indentations would not be assimilated into the inland waters of a littoral State.

Prior to the Conference, the Department of State sought the technical advice of the Coast and Geodetic Survey on matters relating to the delimitation of the marginal belt, a significant aspect of which was the determination of the status of an indentation of the coast. The then Director of the Survey, Rear Admiral Raymond S. Patton, studied this problem and prepared a memorandum entitled "The Three-Mile Limit," which was sent to the American delegation at the Hague.

THE UNITED STATES PROPOSAL (The Semicircular Method)

On the status of bays, the memorandum stated:

> The term "bay," as actually applied in common usage, is so indefinite as not to be susceptible of precise definition which is at once inclusive and exclusive. A bay is a subordinate adjunct to a larger body of water; a penetration of that larger body into the land; a body of water between and inside of two headlands. . . .
>
> In theory, the question whether a bay is intra- or extra-territorial would seem to depend upon the extent to which the waters penetrated into the land, or, more precisely, upon the ratio of that penetration to the dimension of the entrance.
>
> Can that ratio be expressed satisfactorily in mathematical terms? To state briefly the conclusion, without discussing all the considerations by which it was reached, a semicircular bay having its diameter along the line joining the headlands is the theoretical, ideal bay which lies on the borderline between intra- and extra-territorial bays. It is not a perfect rule, but probably as satisfactory a one as can be derived, to assume with respect to such a theoretical, ideal bay, that if more than half the full circle lies inside the line joining the headlands, the bay is intra-territorial, while if less than half lies inside that line, the bay is extra-territorial.
>
> Bays in nature are never exactly semicircular, and we must therefore resort to the theory of equivalence. A possible rule would be "If the area of the natural bay, included within the low-water line and a line joining the headlands, exceeds the area of a semicircle whose diameter is equal to that part of the line joining the headlands which lies outside of the low-water line, the bay is intra-territorial."
>
> Area is a better unit of comparison than perimeter because the irregular form of the low-water line tends unduly to lengthen the latter.

It is of interest, in reviewing the origin and background of the method, to quote from the letter of acknowledgement sent to Admiral Patton by the technical adviser to the American delegation:

> You may also be interested to know that your suggestion with reference to the definition of a bay hits upon a new principle which has been independently arrived at by the British delegation. That delegation is staying in the same hotel and we have had a number of informal discussions. Their proposal, as they first hit upon the idea, was that the ratio of area to width of a bay which is on the borderline between a closed and an open bay be that of a square whose sides were equal to the width of the bay. They had measured the width and

area of a number of bays in various parts of the world, and had come to the conclusion that there were well-defined bays which were smaller in area. We had been discussing it together and had just begun to experiment with the idea of a semicircle when your letter with the precise formula was received. It strengthens our confidence in the idea very much since you have independently reached the same conclusion.

The semicircular rule was embodied in the proposal of the delegation of the United States and was referred to the Second Subcommittee of the Conference for consideration. The committee reported the United States proposal along with a proposal made by the French delegation (referred to later), but expressed no opinion on either one.[2] The Conference adjourned without taking any definitive action on this matter. (The first published discussion of the United States proposal appeared in the *American Journal of International Law,* Vol. 24, p. 541 (1930), in an article by S. W. Boggs entitled, "Delimitation of the Territorial Sea.")

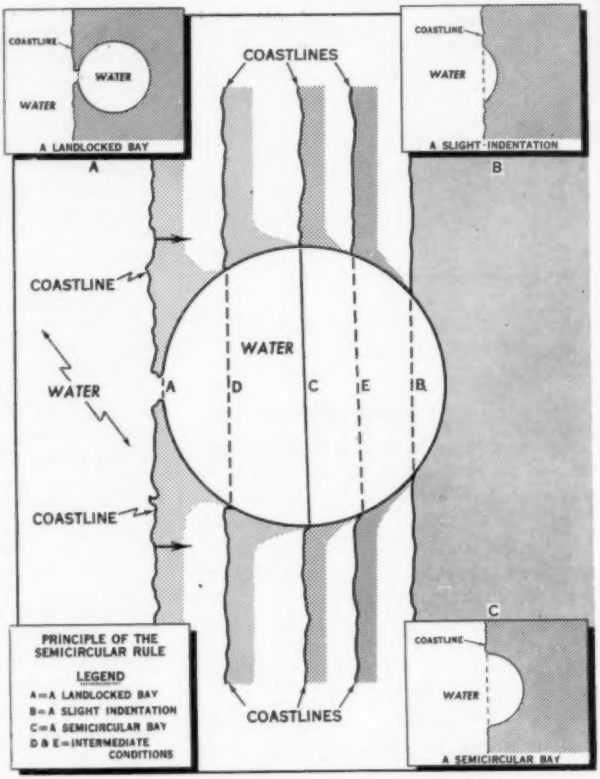

FIGURE 1.—Principle of the semicircular method.

Application of the Method

In concept, the method is quite simple. It may be referred to as the "semicircular method" because the basic consideration is the pattern of a semicircle. The guiding principle of the method can best be illustrated by reference to figure 1. Suppose we consider several hypothetical coastal indentations, ranging from a completely landlocked bay at *A*, which would be the ideal bay, to a slight curvature in the coast, as at *B*, all based on a circle of fixed diameter. The circle is adopted as the theoretical bay because it is the simplest of geometric figures that simulates a bay in nature. The bay terminating at *A* would be the extreme of a closed bay, being almost completely within the surrounding land area, and would be without question inland waters.

[2] Acts of the Conference for the Codification of International Law, The Hague, March 13 to April 12, 1930, pp. 218–219.

The indentation at *B*, on the other hand, is so slight in relation to the full circle, as to be almost wholly without the land area. It would be the extreme of an open bay, and would without doubt be outside of the inland waters. In passing from *A*, the closed bay, to *B*, the open bay, there will be indentations that are more within the land area than without, such as at *D*, and there will be indentations that are more without the land area than within, such as at *E*. There will be one indentation, *C*, at the half-way point, which will be just as much within the land as without. This is the bay formed by the semicircle whose diameter is the distance between its headlands. (It is shown as an inset in the lower right-hand corner of the figure.) It will be the theoretical bay which is on the borderline between an open and a closed bay, and gives a yardstick for determining the status of a coastal indentation. Since bays in nature are seldom exactly circular, we resort to the theory of equivalence, and adopt the rule that if the area of the bay in nature is greater than the area of the semicircle formed with the distance between the headlands as a diameter, the bay is a closed bay and the seaward boundary of inland water is the headland-to-headland line. If the area of the bay is less than the area of the semicircle, the bay is an open bay and the boundary line of inland water would be the ordinary low-water mark following the sinuosities of the coast.

This is illustrated in figure 2. Curve *A* is a true semicircle whose diameter is the line *DE* joining the two headlands of the indentation. If the shoreline of the indentation, whose status is to be determined, is Curve *B*, it is readily apparent that area *DBE* is greater than area *DAE*. The indentation is therefore a closed bay and would be part of the inland waters of a country. But if the shoreline of the indentation is Curve *C*, then area *DCE* is less than area *DAE* and the indentation is an open bay and outside of the inland waters. If the area is exactly equal to the semicircle, the indentation should be regarded as inland waters.

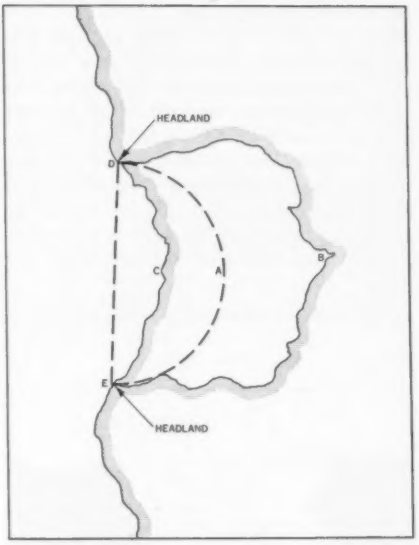

FIGURE 2.—The United States Proposal.

Use of Reduced Areas

That is the essence of the United States proposal. In applying the method to a coastline, it will be found that in a great many cases a visual comparison between the area of the bay in nature and the area of the semicircle will suffice to determine its status, as would be the case with a landlocked or nearly landlocked bay. There will be cases, however, that approach the borderline and for which a more exact comparison will be required. Often there will be minor indentations in a bay that should be ignored for practical purposes. In the case of estuaries there might be a question how far up the river to go in measuring the area. To avoid the latter difficulty and to generalize the shape of the bay so that a comparison of areas may be more readily accomplished, S. W. Boggs, geographer of the State Department, proposed a technique of drawing arcs of circles (similar to arcs used for drawing the marginal sea) around the shore of the bay, using as a radius a proportionate part of the distance between

headlands—for example, one-fourth, one-fifth, etc. Since the envelope of these arcs (envelope is used here in the sense that it is the continuous series of intersecting arcs which are farthest seaward of all possible arcs that could be drawn from the shoreline) will enclose an area within the bay which is less than the area of the whole bay, it is compared not with the full semicircle across the headlands but with a new semicircle whose radius is correspondingly reduced. (*See* fig. 3.)

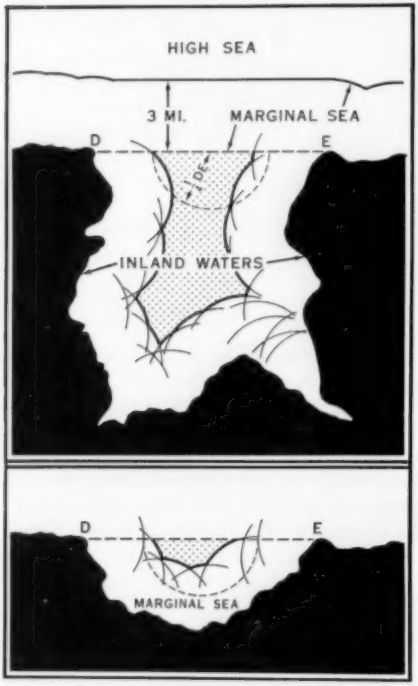

FIGURE 3.—Envelope method for determining the status of an indentation. (After Boggs.)

The use of reduced areas changes somewhat the ratio of the areas being compared, the change depending upon the extent to which the bay departs from a semicircle, but the basic concept of the method is retained. The particular fraction of one-fourth was proposed by the United States delegation in 1930 and was embodied in the Report of the Second Subcommittee. It will be satisfactory for most shoreline conditions. However, if this generalizes the shape of the bay too much, a smaller fraction can be used; or the arcs of circles dispensed with altogether, since in the final analysis the underlying principle of the method is the ratio of the area of the whole bay to the area of the full semicircle across the headlands. The use of reduced areas is but a convenient technique for making the comparison; it is not an integral part of the method.

Unless this basic concept is kept in mind, as well as the reason for development of the method, its application to certain indentations may lead to some absurd results. For example, it was recently testified before a Congressional Committee, holding hearings on the seaward boundaries of the United States, that if the proposed technical method were applied to San Diego Bay (using one-quarter the headland-to-headland distance as a radius for the arcs of circles within the bay) the bay would become part of the high seas.[3] (*See* fig. 4.) Such a conclusion reflects a three-fold misunderstanding of the application of the technical method. Firstly, it takes but a visual comparison to see that the area of the bay is greater than the area of the semicircle drawn from headland to headland, and therefore the bay is inland waters. Secondly, if arcs of circles are drawn from the shores of the bay, with radius of one-quarter the distance between headlands, the arcs will, it is true, overlap in the narrow entrance channel and in the narrow portions inside the bay, and will not enclose any area, but the method does not preclude using other enclosed areas of the envelope line for comparison with the semicircle. All the enclosed areas must be considered, because the status of the entire bay is being determined and not just one portion of it. It is quite obvious that under this test the bay would be inland waters. Thirdly, it is not necessary, in the case of such a con-

[3] Unpublished hearings on H. Res. 676, 82d Congress, 2d Session—Determination of the Seaward Boundaries of the United States.

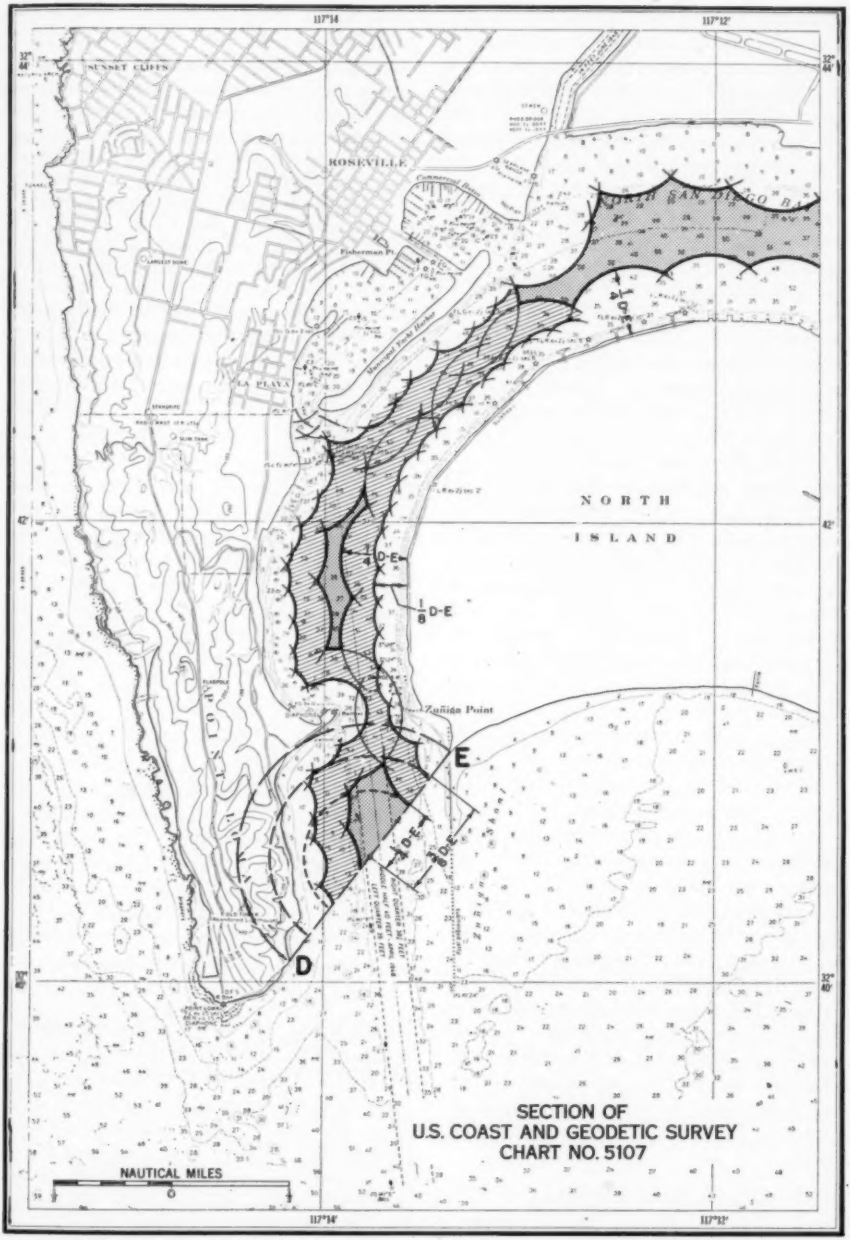

FIGURE 4.—Application of the semicircular method to San Diego Bay.

figuration, to limit the fraction of the headland-to-headland distance to one-quarter. If a smaller fraction, such as one-eighth, is used (as shown in the figure), the arcs of circles within the narrow entrance channel will not overlap, and a continuous enclosed area between the arcs of circles and the headland line will result that is greater than the area of the corresponding semicircle, and the bay would be classified as inland waters.

But beyond all this is the overriding fact that the bay would be inland waters under the general principle laid down in the North Atlantic Fisheries Arbitration of 1910, and no technical method is required to determine its status. The technical method was intended as an extension of the 1910 principle and not a contraction of it. Therefore, those indentations that possess the "configurations and characteristics," referred to in the 1910 Arbitration, would be classified as inland waters anyway. It is only those indentations for which it may be difficult to determine whether the "configurations and characteristics" are present, that more specific criteria are proposed. In other words, the technical method begins where the Arbitration of 1910 left off.

Perhaps a more logical approach to the application of the technical method to an indentation of the coast, particularly where pockets, coves, or tributary indentations exist, is to establish a secondary rule which would provide for determining, in the first instance, the status of such pockets, etc. The principal rule would first be applied to these tributary indentations; if they become inland waters, a headland-to-headland line across them would have the effect of generalizing the main indentation and would simplify a comparison of its area with the area of the semicircle. If the tributary indentations do not become inland waters, then they should be taken into account in determining the status of the main indentation.

THE FRENCH PROPOSAL

At The Hague Conference of 1930, the French delegation proposed the following method for determining the status of an indentation:

> In order that an indentation may be properly termed a bay, the area comprised between the curve of the coast and its chord must be equal to or greater than the area of the segment of the circle the center of which is situated on the perpendicular to the chord in its middle, at a distance from the chord equal to one-half of the length of this chord and of which the radius is equal to the distance which separates this point from one end of the curve.

This method is illustrated in figure 5, which is an identical coastline with that shown in figure 2, and to the same scale.

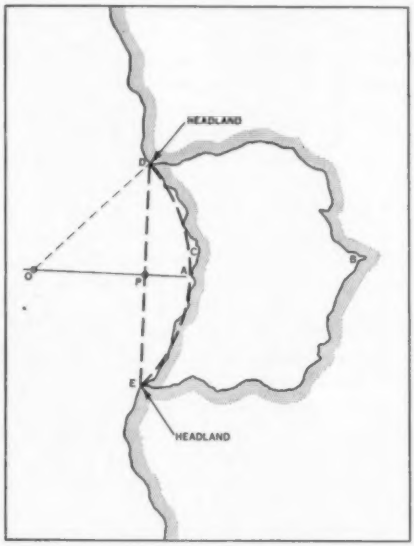

FIGURE 5.—The French Proposal.

In the figure, *OP* is the perpendicular bisector of *DE*, and *OD* is the radius of the arc *DAE*. Under the French proposal, the segment *DAE* becomes the borderline case. Since the area of the indentation *DCE* is greater than the area of the segment *DAE*, the indentation would be classified as inland waters under this proposal. Under the United States proposal, it would be part of the open sea. The indentation *DBE* is of

course inland waters under either proposal.

As a commentary on the French proposal, it should be noted that no basic physiographic principle is discernible in the concept, and it presents no more than an arbitrary solution. Any one of a number of segments to the right or to the left of *C* could be selected, with equal propriety, as the criterion, whereas the United States proposal—the pattern of a semicircle—is a definite physiographic concept realistically associated with the land and water relationship. Both proposals, of course, provide for a 10-mile limitation on bays, following the recommendation of the North Atlantic Fisheries Arbitration of 1910, but this is a matter of political expediency and does not really affect the geometric concept of inland waters. However, on this point, it seems to the writer, the French proposal fails in essence to reflect the wishes of most delegations to the Conference of 1930 that they would agree "to a width of ten miles provided a system were simultaneously adopted under which slight indentations would not be treated as bays." (Acts of Conference, 218.)

CONCLUSION

It should be pointed out that, considering the nature of the problem and the infinite variety of coastlines and indentations that might be encountered, no mathematically perfect method is possible. The technical method proposed by the United States avoids an arbitrary solution and offers at least a rational approach to the inland waters problem. The principle of the semicircle was applied in 1930 by the United States Tariff Commission for determining the dividing line between the territorial sea and the high seas along the coast of the United States, in connection with a fisheries investigation. The Bureau of the Census also used the principle in its consideration of the area of the United States and of the individual States as part of the 1940 Census. (*See* "Measurement of Geographic Area," by Malcolm J. Proudfoot, U. S. Bureau of the Census, 1946, p. 33.)

The semicircular rule, together with the 10-mile limitation, was also urged by the Government of the United States in proceedings before a Special Master appointed by the Supreme Court, in the case of *United States* v. *California,* 332 U.S. 19, to recommend, among other things, criteria for the determination of the seaward limits of inland waters. The Special Master reached the conclusion that the semicircular rule is "an appropriate technical method of ascertaining whether a coastal indentation has sufficient depth [extent of penetration into the land] to constitute inland waters within the limitation of the ten-mile rule." (*See* "Report of Special Master," October 14, 1952, pp. 3, 10.) No final action has as yet been taken by the Court.

A Committee of Experts meeting at The Hague in April 1953, under the aegis of the International Law Commission of the United Nations to study problems in connection with the delimitation of the territorial sea, adopted, subject to the approval of the Commission, the following definition of a bay, as opposed to a mere curvature in the coastline: "A bay is a bay in the juridical sense, if its area is as large as, or larger than, that of the semicircle drawn on the entrance of that bay."[4] This is the semicircular rule. The Committee did not adopt the technique of using reduced areas, but rested the criterion entirely upon the ratio of the whole area of the bay to the area of the full semicircle across the headlands. This is in accord with the statement made above in the section on "Use of Reduced Areas," that in the final analysis the underlying principle of the semicircular method is the ratio of the area of the whole bay to the area of the full semicircle across the headlands. The Committee also adopted a 10-mile limitation on bays, stating: "The closing line across a (juridical) bay should not exceed 10 miles in width, this being twice the range of vision to the horizon in clear weather, from the eye of a mariner at a height of 5 meters." This is a somewhat different basis for the 10-mile

[4] Report of the Committee of Experts on Technical Questions Concerning the Territorial Sea, The Hague, April 14–16, 1953.

rule than is generally given in the literature, but the result is the same.

Many problems will of course arise in applying the method to a complex coastline, particularly when used in conjunction with the 10-mile limitation, and it may be necessary to establish a set of secondary rules within the framework of the primary rule to facilitate application of the method. However, no complete body of rules could ever be devised to meet every possible condition, but if a rule of reason is followed there should be no difficulty even in the most complex of coastlines.

Index Map Shows Status of Aerial Photography

Aerial photography now covers the entire United States, except for a few Rocky Mountain areas, a small part of Maine, and some of the desert country of Arizona and Nevada. The status of this coverage by Federal, State, or commercial agencies is indicated on a new index map just made available by the Map Information Office of the U. S. Geological Survey. The present map, sixth in a series intended to present a periodic inventory of areas in the United States that have been photographed, shows that many projects have been completed since the fifth edition was published in January 1951.

Records pertaining to maps, aerial mosaics, geodetic control, and related data are maintained, in addition to aerial photography data, in the Map Information Office. Requests for such information and for the index map (which is free of charge), should be sent to the Map Information Office, U. S. Geological Survey, Washington 25, D. C.

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Recent Developments in Negative Scribing

By CHARLES F. FUECHSEL
U. S. GEOLOGICAL SURVEY

TWO or three years ago a rather remarkable phenomenon occurred in cartographic circles. That was a rediscovery, so to speak, of the inherent advantages of engraving on glass or plastic sheets, over drafting and photography, for the production of monochrome and multicolor maps. The remarkable element in this rediscovery was the rather uniform sequence of trial-enthusiasm-adoption which took place more or less simultaneously in many quarters.

Several governmental mapping agencies and many commercial lithographers have utilized glass engraving methods in some form for many years. Over 25 years ago the R. H. Randall Company demonstrated that in addition to the advantages of direct processing and excellent quality of reproduction, field men could be trained to produce acceptable line work during short office assignments. This certainly indicated that the trade had acquired a medium which did not require that final rendering be confined to a select and more or less permanent group of skilled draftsmen. Despite the fact that for many years a few cartographers had recognized the potentials of engraving, it was only recently that an adequate number of proponents materialized to "break the ice" on a broad front in the cartographic field. Since that critical point has been passed, enthusiasm for engraving has spread with remarkable speed—perhaps a bit too rapidly for the development of instruments and base materials to keep pace with requirements.

Now the earlier proponents are somewhat concerned that tendencies toward hurried conversions to scribing may bring some disappointments. At this stage we should be inclined toward underselling the procedure somewhat, in the hope that adoptions will be made in a more studied and methodical manner. This will allow for the orderly development of "tools of the trade" to meet the much broadened scope of requirements.

In view of these considerations, as well as in recognition of the great surge of recent interest in negative engraving or scribing, and its broadening field of application, the Cartography Division of ACSM decided to devote their whole program at the Thirteenth Annual Meeting to a complete coverage of this timely subject. A panel discussion was therefore arranged on "Plastic and Glass Engraving Versus Drafting." Representatives of the principal mapping agencies who have objectively examined both methods, presented papers summarizing the views of their respective offices regarding the relative merits of the two processes. The panel members, and agencies that they represented, were as follows:

Samuel Sachs
Chief, Research Section
Reproduction Branch
Coast & Geodetic Survey

H. W. Whitlock
Chief of Cartography
Division of Soil Survey
Soil Conservation Service

Frank A. Clemens
Chief, Cartography Division
Aeronautical Chart & Information Center
U. S. Air Force

Archer M. Wilson
Chief, Map Compilation Techniques Section
Engineer Research & Development Laboratories

A. A. Gioiosa
Chief, Cartographic Division
Army Map Service

C. F. Fuechsel (*Chairman*)
Chief, Cartography Staff Section
Topographic Division
Geological Survey

Publication approved by the Director, U. S. Geological Survey.

In addition, Gordon Littlepage, Chief, Reproduction Branch, Coast and Geodetic Survey, gave an informative summary of wage-hour versus classified service considerations.

Each of the agencies represented on the panel has contributed very substantially to the research and development accomplishments to date in the field of engraving. Their spokesmen on the panel have closely partaken in these activities. In this connection we should also acknowledge the selling efforts of many of their colleagues in the cartographic and lithographic fields who have carried the torch for negative engraving for many years.

It was originally planned that the panel papers, as well as a summary of the subsequent discussion period, would be published in SURVEYING AND MAPPING. However, the appraisals and viewpoints expressed were rather uniformly favorable toward negative engraving, and the papers naturally covered somewhat similar experiences and observations. These mutual substantiations of views were quite effective and made it evident that a great basic change in cartography was at hand. However, insofar as publication is concerned, it appeared more appropriate to summarize the general import of the papers and to cover recent developments for publication in this issue of the Journal. The following observations are therefore presented as a cross-section of the facts and opinions expressed by the panel members, with slight modifications to account for developments to date.

BACKGROUND

During the last few years considerable attention has been given to the potential advantages of scribing on plastic sheets, over conventional smooth-drawing on paper, for copy preparation and map reproduction purposes. This is an adaptation of engraving on glass—a procedure used to limited extents in some sectors of the graphic arts field for many years. Engraving on glass was a natural development from the use of wet-plate photography in photo-processing of maps and other line copy. The normal course of "touch-up" and correction work gradually developed skilled groups with competence for more extensive work on glass negatives, such as color separation of copy containing the line data for more than one printing plate. In turn, this led to the engraving of complete sets of wet-plate negatives, which were stained so that the photographed guide copy remained visible to the engraver, but only the lines which he cut on each negative through the stained emulsion would process to the respective printing plates. Although this procedure was used by some mapping organizations with considerable success, the much greater portion of maps produced in earlier years were rendered by copper-plate engraving and the hand-transfer process.

In 1934 a special committee of the Science Advisory Board, set up to review activities of Federal mapping agencies, strongly recommended the technique of glass engraving rather than copper engraving. However, the rapid increase of mapping activities prior to World War II combined with the decentralization of copy preparation units created transportation and storage problems that discouraged any effective adoption of the Committee's recommendation. At that time the plastic industry was in its infancy and a suitable substitute for glass was not available. Subsequently, smooth-line color-separation drafting and photo-process reproduction gained the ascendancy. It was not until the past year or two that a truly widespread interest has at last developed in the apparent advantages of negative engraving, over drafting, for multicolor map production.

Most of the major map-producing agencies are now converting as much of their production work as feasible to engraving on glass or plastics. The term "scribing" has been more or less generally adopted for the work that is now performed mainly in cartographic offices—perhaps to distinguish this operation from the kindred negative touch-up and engraving work which has long been a limited part of the routine in some map-reproduction plants.

EVALUATION

The results of the coordinated efforts of mapping agencies to date, in experimental as well as production work in negative scribing, are evaluated in the following summary appraisal:

1. *Advantages*

(*a*) Producing operators can be developed from inexperienced recruits in a relatively short time, and proficiency is gained much more rapidly than has been possible under the smooth-line drafting procedure.

(*b*) The quality and consistency of scribed lines in general are improved over smooth inking; the proper contrast of light and heavy contours is more constantly retained, and, in general, superior reproduction is achieved as the "hand" work is in most cases processed directly to the press plates rather than by camera and glass negatives.

(*c*) Experience to date in various types of map and chart work shows a mean increase of 20 to 30 percent in man-hour production over the usual averages for drafting with ink. It is reasonable to expect some further advances as templets and other short-cut aids are developed.

(*d*) Savings in material and storage facilities, as well as labor, are possible because base materials are less bulky and, as the process is more direct, fewer "stages" and working mediums are involved, for example, one set of plastic sheets replaces a set of metal-mounted boards as well as a set of glass negatives for a given map.

(*e*) Metal-mounted and other drawings sometimes deteriorate rapidly, whereas glass engravings have indefinite longevity for revision and re-use. It now appears that maps scribed on plastic may also remain in good condition for many years; this remains to be proved as experience has been limited to only a few years thus far. Perhaps some "embalming fluid" may be found—possibly in the form of a plastic spray—to assure the preservation of scribed sheets for long periods of revision and re-use. It should also be noted that revisions—particularly deletions—are much more readily made on scribed negatives than on pen-and-ink drawings. "Paint-outs" are speedily accomplished, and this may be done repeatedly in the same areas without damaging the negative surface.

(*f*) An important *potential* advantage of scribing is the fact that it offers a wider field for application of short-cut techniques, templets, and related aids. Gadgeteers have already made extensive contributions to the rather meager tools-of-the-trade that existed a year or two ago. Doubtless, instruments in general—particularly short-cut aids, coatings, base materials, and techniques will be greatly advanced in the near future. Many groups are being brought into the field and it is reasonable to expect much progress from this influx of new talent.

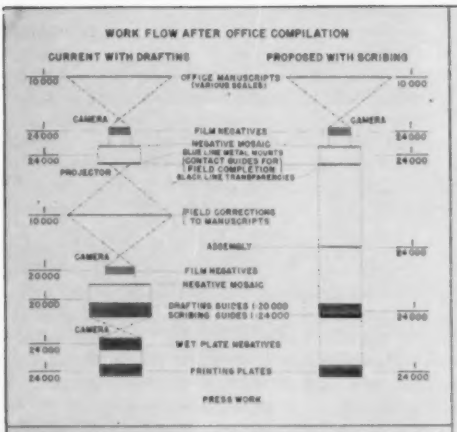
2. *Disadvantages*

(*a*) The application of lettering and figures presents some problems. However, these problems are not serious and solutions for the more troublesome items will doubtless be found in the near future.

Lettering may be set up in the usual manner, but on a separate sheet, then photographed and combined on the press plate; or, negative labels can be "stripped-in" on the respective line engravings. Both of these operations are slightly more troublesome than placing numbers and lettering directly on the drawings. Another method is to make a contact positive from the line engraving and place the lettering and figures on it; however, this process also has the disadvantage of requiring photography, or another contact printing to make reproduction negatives. The possibilities of using guides or pantogravers for much of the lettering and figures required on maps and charts are now very promising. Several groups are working in this direction and it may develop that the lettering handicap will eventually be changed to an advantage. Stick-up lettering has some drawbacks, and the direct engraving of figures and letters would be advantageous, providing it can be accomplished in something near the total time required to list, requisition, print, cut, and stick the conventional printed type.

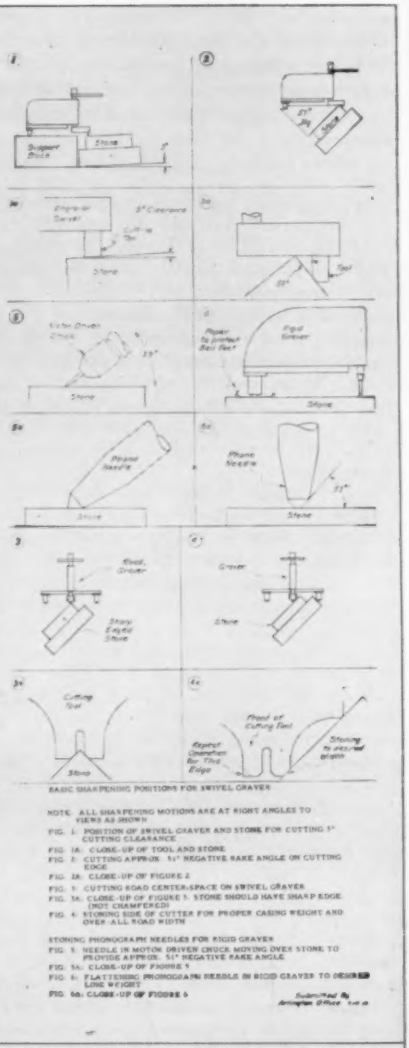
(*b*) The application of "stick-up" patterns such as sand and swamp, used extensively in recent years to save drafting time, also presents some difficulties. The problem here is similar to that of lettering and, again, is not too serious. The current practice is to set extensive "Zip" areas on a separate sheet, or to spade out for direct placements on the line negatives. There are several possible solutions for this problem, but as yet none are very close to achievement and, for the present, scribing must admit to a disadvantage here.

(*c*) Base materials and coatings are sometimes troublesome, just as are papers, inks, and the extra photographic steps involved with the drafting process. In all fairness to the latter procedure, it is probably true that, to date, coat-



OPERATOR USING SWIVEL SCRIBER

COATING PLASTIC IN HORIZONTAL WHIRLER


BASIC SHARPENING POSITIONS FOR SWIVEL GRAVER
NOTE: ALL SHARPENING MOTIONS ARE AT RIGHT ANGLES TO VIEWS AS SHOWN
FIG. 1: POSITION OF SWIVEL GRAVER AND STONE FOR CUTTING 5° CUTTING CLEARANCE
FIG. 1A: CLOSE-UP OF TOOL AND STONE
FIG. 2: CUTTING APPROX. 1/4° NEGATIVE RAKE ANGLE ON CUTTING EDGE
FIG. 2A: CLOSE-UP OF FIGURE 2
FIG. 3: CUTTING ROAD CENTER-SPACE ON SWIVEL GRAVER
FIG. 3A: CLOSE-UP OF FIGURE 3. STONE SHOULD HAVE SHARP EDGE (NOT CHAMFERED)
FIG. 4: STONING SIDE OF CUTTER FOR PROPER CASING WEIGHT AND OVER-ALL ROAD WIDTH
STONING PHONOGRAPH NEEDLES FOR RIGID GRAVER
FIG. 5: NEEDLE IN MOTOR DRIVEN CHUCK MOVING OVER STONE TO PROVIDE APPROX. 5/1° NEGATIVE RAKE ANGLE
FIG. 5A: CLOSE-UP OF FIGURE 5
FIG. 6: FLATTENING PHONOGRAPH NEEDLE IN RIGID GRAVER TO DESIRED LINE WEIGHT
FIG. 6A: CLOSE-UP OF FIGURE 6
Submitted By Arlington Office

SCRIBING INSTRUCTIONS ARE MANY AND VARIED THE ABOVE INSTRUCTION ILLUSTRATES TOOL SHARPENING TECHNIQUE

ings have troubled scribers a bit more than the vagaries of papers, inks, and pens have bothered draftsmen. These drawbacks are rapidly being removed, as the following discussions of these features indicate.

BASE MATERIALS

Authorities generally agree that glass has some advantages over existing plastics for engraving—principally its near-perfect scale stability for register requirements and the harder surface which makes it relatively easy to cut away the emulsion clearly without penetrating the base material. Permanence of glass, for many years of re-use and storage, is also probably superior to any existing plastics. However, the problem of handling glass and shipping it from field offices, has led most agencies who do not have copy-preparation and reproduction facilities in the same location to choose plastic sheets for their base medium. The entire field of scale-stable plastics was therefore subjected to rather close examination by the several agencies concerned. For its first experimental jobs, the Geological Survey chose CR–39, a plastic sheeting developed several years ago by the Pittsburgh Plate Glass Company, under their Columbia Resins research program. This semi-rigid sheeting, which is available in various thicknesses, has a harder surface than other plastics suitable for scribing. However, the scale-stability factor, while close to that of vinyl sheeting, introduced a small calculated risk on register, which led the Geological Survey to convert to the latter medium after initial trials. While the vinyl sheets are not dimensionally stable in an absolute sense, the several plates comprising a given publication are invariably subjected to the same conditions of humidity, temperature, and treatment. It is, therefore, rather unlikely that any serious cases of plate misregister will arise from this source.

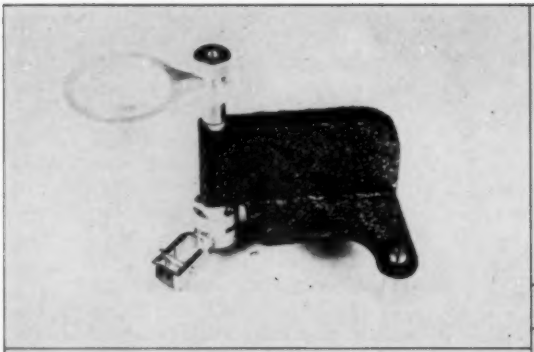
Fiberglass probably has a slight advantage over the other sheetings insofar as dimensional stability is concerned. However, if the surface is penetrated by the scriber an irregular resistance is encountered from the glass-cloth mesh, resulting in slight variations in line sharpness. The mesh core also introduces slight refractions when the sheeting is used as an overlay for copying. These are not serious drawbacks, even for rather-close-tolerance map work, and it appears likely that the plastic bonds may soon be improved. It is therefore possible that, with some improvements, fiberglass could become the generally preferred sheeting for map work in the near future.

Doubtless the plastic sheetings now in production will gradually be improved, and perhaps new base materials affording even better stabilities, textures, and longevity features may be introduced from time to time. Mylar (a polyester resin) is a near-future prospect that may possibly raise the suitability level for many scribing activities. A new vinyl-glass laminate, just introduced, may offer some advantages. For the present, however, the plastics must still bow to glass insofar as optimum dimensional stability, longevity, and hard-surface characteristics are concerned.

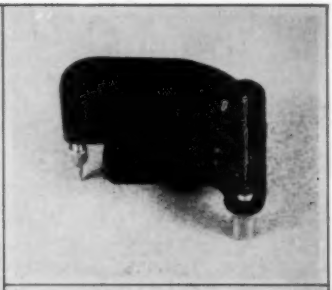
COATINGS

The base coating, an apparently simple element in the negative engraving or scribing process, has probably been the source of more trouble than any of the other elements. In the earlier glass-engraving days it was generally understood that staining emulsions and processes were "tricky" in character. The same formula and procedure would often result in variable textures for cutting—presumably because of differences in humidity or temperature, and possibly because of more elusive chemical variations.

The opaque coatings now most used (yellow Floquil and red Fostercote) are more easily controlled, but are also vulnerable to inadvertent changes in basic content. Shortly after having settled on satisfactory coating procedures, most scribing groups were recently, and rather suddenly, beset with texture difficulties. It was finally discovered, after close inquiry, that the producers of base ingredients had changed formulas without advising their customers.



SWIVEL SCRIBER



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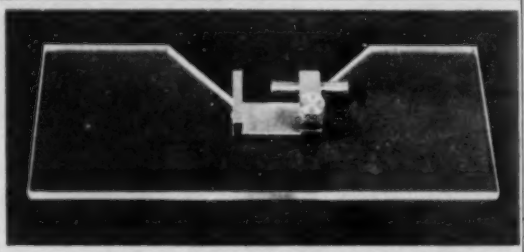
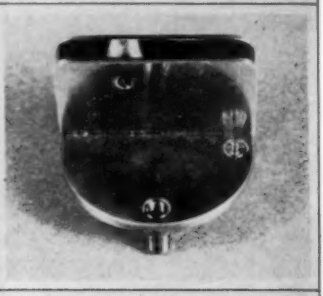
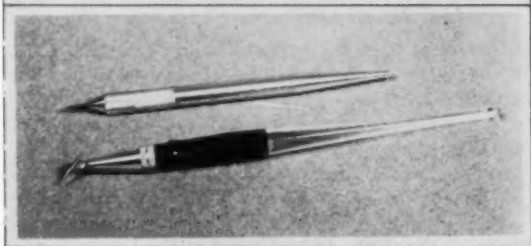


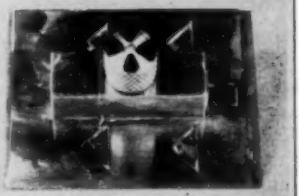
BUILDING GUIDE



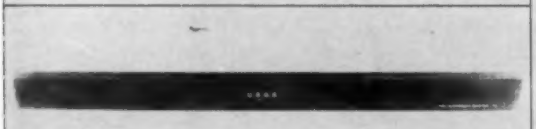
STRAIGHT LINE SCRIBER



PENCIL TYPE SCRIBERS



BARN TEMPLET



8" STEEL STRAIGHTEDGE

HAND MAGNIFIER

SCRIBING INSTRUMENTS

This occurrence served to alert all concerned to the need for stability and constant care in all quarters. We expect little trouble from this particular source for quite some time to come.

Coatings are now usually applied by plate whirler or by spraying. Both are satisfactory, but a more uniform coat is generally achieved by spraying. Roller-coating and silk-screen procedures are also promising methods. Commercial groups are working diligently on these problems and sheets of consistent qualities, from mass-production sources, are now practically assured. Up to the present, most groups have relied on their own photo labs or shops to supply immediate needs, but most agree that economy and consistent quality will best be served through mass-production methods.

GUIDE-COPY EMULSIONS

At the outset, most groups converting to scribing used the conventional blue-print solution and positive guide copy employed for drafting. In most quarters the preference has turned toward darker emulsions and negative copy (light lines and dark background). This return to conventional negative standards gives more assurance of opacity for proving and press-plate making, and reduces glare for the scriber. Various emulsion colors have been tried and the black, or dark green, have proved most popular. The development of pre-sensitized plates, ready for scribing and with a shelf life of a year or two, will be welcomed. Aside from this need, present guide-copy emulsions are generally satisfactory.

INSTRUMENTS

There is a vast field for new instrumental developments and improvement of existing instruments. Already the engravers' tools and guides have been greatly advanced over those available to him a short time ago. Mass-production sources for templets, lettering and figure guides, and a wide variety of short-cut aids are being developed. The accompanying illustrations show the principal instruments in use today, and those in advanced stages of development. It is in this field of "side arms" that the major advances toward the perfection of scribing will be made in the immediate future.

The application of scribing to other phases of map and chart production, as well as preparation for reproduction, is likewise of considerable importance. The Geological Survey, among others, is experimenting with its use in basic compilation and field-survey operations. The accompanying diagram illustrates the potential benefits of the current effort toward simplifying the cartographic cycle as a whole. It is hoped that, in the near future, representatives of the Federal mapping agencies can get together for a round-table discussion of scribing in all its ramifications. Perhaps the field of research and development could be apportioned in some manner to avoid duplication of effort, and thus make greater advances from the community effort as a whole. A general review of map symbolization, to adopt the slight modifications that may facilitate scribing, would also be in order. We are sure there will be many interesting developments, in the scribing field as a whole, to report upon a year or so hence.

JUDICIAL FUNCTIONS OF SURVEYORS

In reply to a recent letter from the Congress, John P. Goggin[1] states that he has prepared copies of Chief Justice Cooley's article, "Judicial Functions of Surveyors," for dissemination to interested readers. Mr. Goggin cited this paper as recommended reading for property surveyors in his recent article[2] in the Journal, and stated that it contains the philosophy of the legal aspects of surveying.

[1] Mr. Goggin's address is Marathon, Fla.

[2] Land Survey Problems in the Florida Keys, by John P. Goggin, SURVEYING AND MAPPING, Vol. XIII, No. 3.

Problems of the Texas Surveyor

By J. STUART BOYLES

REGISTERED ENGINEER AND LAND SURVEYOR, HOUSTON, TEXAS

THE PROBLEMS of the Texas surveyor are complicated by the fact that Texas surveying covers four separate and distinct eras.

The first era was that period when Texas was a part of Mexico and Mexico was under Spanish domination, from the conquest of Mexico to March 15, 1824. The second era was that period when Texas was a part of Coahuilla and Texas, a State of the Mexican Republic, from 1824 to 1836. The third era was that period when Texas was a republic, from 1836 to April 1845, the effective date of the common law in Texas. The fourth era is the period of Texas statehood, from 1845 to the present date.

FOUR ERAS OF TEXAS SURVEYING

During the first era land was plentiful and cheap while money was scarce. This resulted in many salaries being paid in land grants; large areas were given to municipalities (settlements) and other large grants were made to various missions. During this period no grant was made to any person not owing allegiance to Spain. The procedure for making a survey was elaborate and excellent on paper but the actual surveying on the ground was very mediocre. The standard unit of measurement was a cordel, a cordel being a rope or piece of rawhide 50 varas in length. No allowance was made in cordel measurements for stretching in damp weather or shrinking in dry weather.

During the second era, which was the Mexican or Colonial period, huge colonization contracts were made by the Mexican Government with foreign agents. The lands upon which these contracts were made were called Colonies, such as Austin's Colony, Zavala's Colony, and Powers' and Hewitson's Colony. The contracting colonizer was designated "Empresario." The Empresario furnished the actual settlers and also the surveyors for his particular colony. These surveyors were practically all Americans from the Eastern States. The same boundary and surveying laws governed in the second era as in the first. The unit of measurement was a vara; the length of the vara used during this period is a matter of speculation. From a long study of the vara we have found that it varied from 27 to 40 inches in length.[1] The measurements made during this period were very inaccurate; they are usually found to be much greater on the ground than is reflected in the title or patent. There was, so far as I have been able to discover, little if any stream or shoreline meandering.

The third era was the Texas Settlement period when many of the colonial surveyors became District Surveyors. Up to 1840 the same boundary and surveying laws used under the Spanish and Mexican regimes were in effect. Grants for services to the Republic were made to settlers both single and married. Grants were also made for service in the Texas Army and for political purposes, the size of the grant depending upon the value of the service rendered and the size of the family or the political influence. The vara (during this era, length unknown) was the standard unit of measurement and it was not until 1919 that the 36th Texas Legislature fixed the length of the Texas vara at 33⅓ inches.

During the third era it was a prevalent custom, in areas abutting water courses, for the surveyor to meander many miles of the stream before locating the surveys on each

Presented at the Thirteenth Annual Meeting of the American Congress on Surveying and Mapping, March 23–25, 1953, at Washington, D. C.

[1] For a further discussion of the vara, *see* The Variable Vara, by W. C. Wattles, SURVEYING AND MAPPING, Vol. X, p. 198; also the article, "The Texas Vara," by E. L. Harrington, on p. 451 of this issue.

side and abutting the same. There was a definite reason for this—the stream furnished a method of transportation, drinking water, fuel from the timber on the banks, and fish and game for food. These surveyors were supposed to set the back corners (those away from the river) so that the side courses of the surveys were generally at right angles to the course of the stream. This method of surveying — meandering the stream first and setting, or supposedly setting the back corners of the surveys—has been the source of untold grief to later surveyors. In a great many instances, the meanders must have been erroneous, both as to course and distance. Based on erroneous meanders it naturally follows that the back corners were incorrectly calculated or placed. It would be a miracle to find the two lines, one leading away from the river and the closing line back to the river, to be the lengths reflected in the title. If preference be given to the first course out from the river, almost without exception the closing course back to the river either fails to reach the river or crosses it by several hundred varas. If the calls are reversed, and the closing line is given its called length, then the first line either fails to reach the river or crosses it. There are numerous instances where only one side of the river was meandered and the identical meander courses and distances were given for surveys on the opposite side of the river.

Since 1840, at which time the office of County Surveyor was made a Texas Constitutional Office, we have had many persons serving in that capacity. Many of these men were totally unfit and unqualified for the office. Apparently many of them knew little or no arithmetic and in many instances used hunting compasses to determine their courses. These County Surveyors, both competent and incompetent, surveyed large railroad grants and fill-in surveys between the previously titled lands. Their work was so inaccurate that in order to attempt to disentangle the situation the State designated certain men as "State Surveyors." The great majority of these State Surveyors were railroad engineers. Their salaries and expenses were paid by the railroad companies and they were qualified by the State only in order to make their work official. These State Surveyors made resurveys of practically every railroad grant in Texas and these resurveys have been the cause of literally thousands of boundary suits. The railroad land-grant law provided for disposal of alternate sections; the odd-numbered sections were patented to the railroad companies, while the even-numbered sections were reserved for the Public Free School Fund. These resurveys left many vacancies and equally as many conflicts. The unfortunate part of this situation is that the odd-numbered or railroad sections were patented on the original field notes and the even-numbered school sections on the resurveyed notes; the result is chaos.

EARLY CORNER MARKERS

Adding to the woes of the surveyor in Texas is the confusion caused by the type of corner markers used in the early days. In the prairie country a corner was marked with a stake (no description as to size or kind of wood), or an earth mound. Of course the stakes set years ago have long since rotted away and the earth mounds have long since reverted to natural ground.

In the timbered sections where trees were marked for corners or witnesses, I would say that 99 and 99/100 percent of these trees have long since disappeared. They have either died and decayed, been destroyed by fire or storms, or cut by a lumber company. In the area where stone or rock was available, rock monuments were placed for corners. Today only a very, very few of these can be found and fewer yet identified without exhaustive surveying. Some of these have been destroyed; many have been moved to other positions; some have been moved by the resurveyors; some have been maliciously destroyed; and some have been destroyed by landowners to enlarge their survey.

Roads and highways have been built along many survey lines; lumber companies have cut the line trees along survey lines, as well as the corner or witness trees, so that

at this date the surveyor must depend largely upon locative, descriptive, and passing calls to relocate original survey lines.

From a study covering 45 years of the records in the General Land Office of Texas, I am fully convinced that about 90 percent of the resurvey notes were prepared in the office ("office surveys" in Texas jurisprudence) and not actually made on the ground. It is true that in many areas in West Texas certain base lines, sometimes called township lines, were run, but the sections within the township, while given definite metes and bounds and cornermarker calls, were never actually run on the ground.

REPRESENTATIVE CASES ON POINTS OF LAW

The Texas surveyor is confronted with so many points of law, all of which have been tried out in the courts, that it makes interpretation difficult. Listed below are some representative cases on points of law that commonly arise:

Ambiguities: *Humble Oil & Ref. Co.* v. *Ellison,* 134 Texas 140, 132 S.W. 2d 395.

Surveyor's intention (that is to say, that which is read into a surveyor's field notes irrespective of his calls, course, and distance): *Finberg* v. *Gilbert,* 104 Texas 539, 141 S.W. 82; also *Masterson* v. *Ribble,* 78 S.W. 358.

Conflicting calls: *Stafford* v. *King,* 30 Texas 257, 273; *Jaggers* v. *Stringer,* 106 S.W. 151; *Stafford* v. *King,* 30 Texas 257, 272; and many others.

Natural and artificial objects: *State* v. *Ohio Oil Co.,* 173 S.W. 2d 470, 481; *Robinson* v. *Doss,* 53 Texas 496; *Linney* v. *Wood,* 66 Texas 22, 17 S.W. 244.

Adjoinders: *Kirby Lbr. Co.* v. *Gibbs Bros.,* 14 S.W. 2nd 1013, 1014; *Anderson* v. *Stamps,* 19 Texas 460; *Braumiller* v. *Burke,* 112 Texas 390, 247 S.W. 501.

Courses and distances: 79 Texas 413, 420, 15 S.W. 679; *Rand* v. *Cartwright,* 82 Texas 399, 18 S.W. 794, 144 S.W. 2d 378.

Erroneous calls: *New York & Texas Land Co. Ltd.* v. *Thompson,* 83 Texas 169, 17 S.W. 920; *Freeman* v. *Mahoney,* 57 Texas 621, 626; and many, many others.

Following the footsteps: *Linney* v. *Wood,* 66 Texas 20, 30, 17 S.W. 244; *Hart* v. *Greis,* 155 S.W. 2d 997.

Presumptions: *Kirby Lbr. Co.* v. *Adams,* 127 Texas 376, 93 S.W. 2d 382.

Evidence: *Thatcher* v. *Matthews,* 101 Texas 122, 105 S.W. 317.

Lost objects: *Humble Oil & Ref. Co.* v. *State,* 162 S.W. 2d 119.

Reputation: *Cockrell* v. *Work,* 94 S.W. 2d 784; *Blaffer* v. *State,* 31 S.W. 2d 172.

Objects not called for: *Reast* v. *Darnold,* 84 Texas 648, 19 S.W. 795.

Passing calls: *Davenport* v. *Bass,* 137 Texas 248, 153 S.W. 2d 471.

In addition to these, we have limitation, that is, occupancy of a piece of land over a period of time without a record title. We also have general recognition in certain instances.

A surveyor in Texas should have a definite knowledge of Texas boundary law, long familiarity with the archives of the General Land Office, and a working knowledge of the methods of surveyors and of the colonization laws through all of the different eras which have been enumerated above. He should be able to assimilate and retain the greater part of this information and must have the ability to apply this information to his work on the ground.

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Surveyors Check White House Boundaries

THE District of Columbia surveyor's office and the National Park Service are checking up on the boundaries of the White House grounds to clarify who owns what.

This was learned when a crew of surveyors from the Park Service, which has jurisdiction over the grounds of the Executive Mansion, began making chalk marks and stringing lines on the sidewalks around the White House.

Spokesmen for the Park Service and the District emphasized that some of the plats of White House boundaries are so ancient that interpretation is literally curbstone opinion. The purpose of the survey is to make new plats of the White House.—*Times Herald,* Washington, D. C., Oct. 15, 1953.

The Texas Vara[1]

By E. L. HARRINGTON

DEPARTMENT OF CIVIL ENGINEERING, AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

ALTHOUGH the Spaniards began to settle in what is now Texas at a very early date, only relatively small amounts of land were granted by the Spanish Government. After the Mexican Revolution the Mexican colonial laws were liberal, and land that was practically free brought many settlers to Texas. The National Colonization Law of Mexico, issued in 1823, established the *vara* as the unit of land measurement and specified the following in regard to its length:

> The measurement of land shall be the following: Establishing the vara at three geometrical feet, a straight line of five thousand varas shall be a league; a square, each of whose sides shall be a league, shall be a sitio; . . .

The Geometrical Foot (or Philosopher's Foot) was in use among writers and scholars in the 16th and 17th centuries A. D. There is little agreement in regard to its length. Seth Ingram, one of Stephen Austin's surveyors, gave its length as 11.13333+ inches English measure. This value would give a length of 33.4 inches for the vara.

Roman systems of weights and measures were used in Spain until that country was overrun by barbarians in the fifth century A. D. The Moors later conquered most of the country and introduced their systems of measurement. The Roman Foot continued in use but there was no standard value. Provinces and towns had their special systems of weights and measures, the vara usually being the unit of length.

The Spanish word *vara* is of Latin origin and has many meanings—one of which is a unit of measurement. In the 13th century A. D., during the wars against the Moors, James the Conqueror and Alfonso the Wise ordered that the vara of 3 Roman Feet should be used in their dominions. This was an early attempt by the Spanish rulers to standardize units of measurement over a large country. Several varas resulted, the Vara of Castilla being used in many of the provinces. The Vara of Castilla was frequently referred to as the Vara of Burgos because the standard vara was kept in the City of Burgos. The Vara of Castilla is 0.835905 meters long (about 32.91 inches), and is still retained in a show case in the *Sala de Jueces* in the City of Burgos. It remained legal in Spain until that country adopted the metric system.[2]

It was the intention of Spain that the Vara of Castilla be used in the Spanish colonies, but it was difficult to maintain an exact standard of measurement. Measuring was done by use of a *cordel*, a cord of rope usually 50 varas long. The cordel could be soaked in wax, rosin, or water to minimize changes in length. Edmund Gunter (1581–1626) had invented the Gunter Chain which was more precise than a cordel but harder to make and clumsier to use. Steel tapes did not come into general use until after 1850. Because of lack of standards, and also because of confusion in regard to the length of the vara, several varas were in use in the Spanish colonies in the Americas, but many of the colonies had varas that closely approximated the Vara of Castilla. In early surveys in Texas several values were used for the vara. Seth Ingram used a vara of 33.4 inches; James Kerr used a length of 33⅓ inches, and some early surveyors apparently used the English yard of 3 feet.

In 1836 after Texas became a republic, President Sam Houston appointed John P. Borden as the First Commissioner of the

[1] *See also* "The Variable Vara," by W. C. Wattles, SURVEYING AND MAPPING, Vol. X, No. 3, July–Sept. 1950.

[2] Jose Luis Escario, lawyer and highway engineer of Madrid, Spain, furnished much valuable information concerning the Vara of Castilla.

General Land Office of Texas. Mr. Borden was only 24 years old at the time and had been a land surveyor in Austin's colonies. He began the collection of land records and organized the General Land Office along the lines by which it has been conducted to this day. It was absolutely necessary to set a standard length for the vara, as surveyors were using different varas in surveys of the public lands. On January 27, 1838, Mr. Borden issued the following instructions to surveyors concerning the vara:

> The measure to be used will be varas and tenths of varas, or Spanish yards; each surveyor will therefore regulate his chain to the length of ten varas, or, what is the same, 27 feet 9 1/3 inches, the vara being 33 1/3 inches.

Mr. Borden's choice was a fortunate one as it probably approximated closely the length of most of the varas then in use and could readily be converted into English units as 36 Texas Varas equal 100 feet.

When Texas entered the Union it retained its public debt and its public lands, the boundaries of the State extending three marine leagues out to sea. Title to these tidelands has recently been reaffirmed by act of the Congress of the United States. The lands of Texas comprise about 9 percent of the total land area of the United States, and Texas is the only State in the Union that owns its public lands and maintains its own Land Office.

The vara and the foot are legal units of measurement for Texas lands. The Texas Vara is a direct descendent of the Roman Foot and the Vara of Castilla, but no other vara has its same length. On March 24, 1919, the Texas Legislature established the length of the vara as 33⅓ inches thus confirming, after more than 80 years, the decree issued by John P. Borden.

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Use of Electronic Surveying Equipment in Meteorology

By JOSEPH WEIL[1] and M. H. LATOUR[2]
UNIVERSITY OF FLORIDA

ELECTRONIC DEVICES have become more and more a part of everyday living. From the original major use in communications, the electron tube has found uses in medicine, mathematics, all fields of engineering, music, industrial control, transportation, and warfare. Some of these applications of electronics have become so commonplace that they are no longer regarded as engineering marvels. The average passenger in a deluxe airliner never thinks of the complex electronic devices that make his safe trip possible.

There have been many such developments in the civil engineering field also. Many of these were the result of accelerated research during the last decade and the recognition of the usefulness of devices originally designed for other purposes.

One of these devices was SHORAN (SHort RAnge Navigation), designed during World War II primarily as a precision bombing device. Shoran is a radar-type device. Distances are measured by accurate measurement of the time required for radio waves to travel between two points. Descriptions of this equipment have been published in many journals and it is undoubtedly familiar to most engineers interested in long range surveying of inaccessible regions or areas, such as widely scattered islands, where surface surveys are impossible.

Other electronic distance-measuring systems have been designed, such as LORAC (LOng Range ACcuracy), RATRAN (RAdar TRiANgulation), and Raydist. All of these systems have been used to make surveys over areas where conventional methods are not feasible. These methods have been employed widely in oil prospecting in the Gulf of Mexico, where the geographical location of the points of a geophysical survey is of prime importance.

The electronic art is also called upon in making geophysical surveys and seismographic soundings. Electronic instruments are used to measure the earth's magnetic field, and the gravitational field.

Electronic river gages have been devised for reporting of floodwater heights. These unattended stations make possible accurate and continuous check of stream flow from many more points than otherwise would be possible.

The sonar system, used for locating submarines during the war, now is used to measure the contours of the bottoms of lakes, oceans, rivers, and harbors. What was formerly a slow, laborious task with a sounding line is now done rapidly with an instrument which plots a graph of the contours automatically. The instrument not only gives the depth of the water body but will also indicate the depth of the silt layer, an important factor in the new man-made lakes behind our great dams.

A variation of the radar altimeter makes possible the addition of topographical detail to the maps produced from aerial photographs and Shoran. The standard radio altimeter did not provide sufficiently accurate measurements. However, the demands resulted in a radar altimeter which made accuracies of plus or minus 20 feet readily obtainable. Special flying techniques increased the accuracy to plus or minus 10 feet. This special instrument is called the Airborne Profile Recorder. Since it is virtually impossible for the aircraft to fly at a constant elevation above sea level, the flight path follows a constant-pressure surface.

Presented at the Thirteenth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., March 23–25, 1953.

[1] Dean, College of Engineering.

[2] Assistant Professor, Electrical Engineering.

Necessary corrections for the pressure gradient are made so that the heights obtained by each flight can be reduced to elevations above sea level. An electronic device is used with a sensitive aneroid to provide corrections for deviations from level flight.

Many electronic devices are used with the cameras in aerial surveys. Electronically operated shutters and controls are now normal parts of the equipment.

The use of electronic instruments has immeasurably increased the speed of making accurate measurements, which has resulted in the amassing of enormous quantities of data. So much data can be obtained that conventional computing methods for evaluating and reducing to useful form would be far too slow. But electronics has also provided the "electronic brains"—the analog and digital computers, capable of solving problems which would require years to complete, in a fraction of a second.

One field of universal interest that has been entered by the electronic tube is meteorology. Here we have the radiosonde for sampling the upper atmosphere. Not only does this utilize the radio transmitter for transmitting the information of temperature, humidity, and pressure, but also the measuring elements themselves are electrical devices. The radio direction finder has been put to use to measure the elevation and azimuth angle of the upper atmosphere sounding balloon, making possible the calculation of wind velocities high above the earth beyond the range of the theodolite.

Radar has also proved to be a very valuable tool in location of weather. Precipitation areas can be detected by radar over vast spaces. Storms, such as hurricanes, can be

FIGURE 1.—The position of thunderstorms can be determined from simultaneous bearings obtained by the Sferics Automatic Direction Finder. Increased accuracy can be obtained with three or more stations.

located and tracked even when far removed from ground observation points.

Radio direction-finding techniques also have been applied to the location of electrical disturbances. Thunderstorm areas have been plotted as far as 2,000 miles from the observing station with this electronic instrument.

Storm location by means of associated radio static or "sferics" (a contraction of atmospherics) is based on locating the simple natural phenomenon of radio static associated with lightning discharges with which all radio listeners are familiar.

The atmospheric direction finder renders an indication corresponding to the direction of arrival of "static" signals, and hence the storm with reference to the point of observation. Two or more widely separated stations can then be organized into a network taking simultaneous observations on the same signals. From these data the origin of the "static" and hence the storm position may be determined by triangulation methods.

This program was initially conceived as a method of locating hurricanes by triangulation of the radio static emanating from these storms. A triangulation network was set up in 1935 with stations at the University of Puerto Rico and the University of Florida, giving a base line of approximately 1,100 miles.

Intensive research was conducted for several years on this program. In addition to the static direction-finder units installed at the University of Florida and the University of Puerto Rico, additional units were set up at Miami and Pensacola. Data were taken during several tropical storms. The results of these studies have been published in "The Location of Tropical Storms by Means of Associated Static," by Joseph Weil and Wayne Mason, *Engineering Experiment Station Bulletin No. 3*, 1936; and "On Static Emanating from Six Tropical Storms and Its Use in Locating the Position of the Disturbance," by S. P. Sashoff and Joseph Weil, *Proceedings of the Institute of Radio Engineers*, Vol. 27, 1939.

Although the efforts to locate hurricanes with this technique did not prove successful,

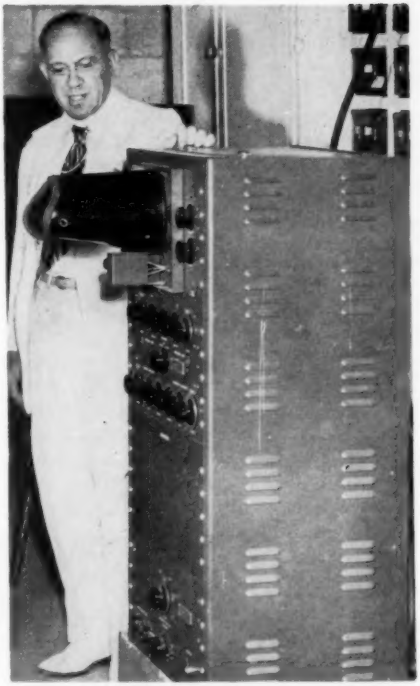

FIGURE 2.—Dean Joseph Weil with the Sferics Automatic Direction Finder unit produced by the University of Florida.

two significant facts were determined: (1) the amount of static or atmospheric noise generated in a hurricane was insignificant (heavy electrical activity had been assumed previously) and (2) thunderstorms and areas of electrical activity could be located with great accuracy at considerable distances.

When in 1944 the U. S. Army Signal Corps desired meteorological equipment for the long-range location of storms, they first contacted the early pioneers in this field of study, Sir Watson-Watt and his colleagues in England. This group, then busy on the development of radar, referred the Signal Corps to the University of Florida.

In 1944 the United States Signal Corps placed the first of a series of contracts with the Engineering and Industrial Experiment Station of the University of Florida to design

and develop compact instruments suitable for use in the active war theaters for the location of storms over enemy territory by means of the associated radio static.

Eighteen of these unusual instruments, designed and constructed in the laboratories of the University of Florida, were placed in action during World War II in the Caribbean, Mediterranean, China-Burma-India, and Pacific War Theaters, and there provided valuable information on current weather conditions over bombing targets to the Army Air Force.

The demand for atmospheric direction finders was so great during the last war that these instruments were placed into actual use before many of the factors affecting their use had been adequately studied. War-time experience has revealed definite possibilities for the "sferics" direction finder as a meteorological tool. The Engineering and Industrial Experiment Station of the University of Florida is, therefore, continuing this research in an endeavor to advance the science of accurate weather forecasting.

One of the newest developments in the field of meteorology is the use of radar as a research and observational tool. Radar operators in World War II noticed certain images on their receiving screens which were obviously not from aircraft. These were soon identified as reflections from raindrops in precipitation areas within the range of the radar set. The intensity of these reflections is determined by the size and number of raindrops and also by the distance to the precipitation area. The plan-position-indicator (PPI) of the radar normally used for storm observation is a cathode-ray tube similar to the picture tube in a television receiver. Echoes from precipitation areas and aircraft appear as

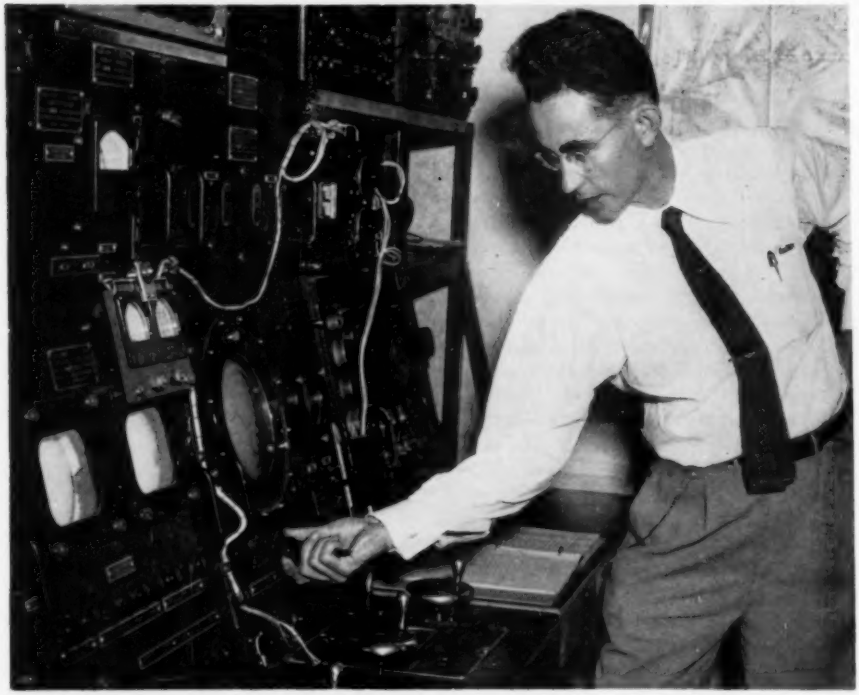

FIGURE 3.—The weather radar operations console. Professor Latour adjusts the range switch of the main Plan Position Indicator scope.

a bright spot on the screen of the tube in its proper compass direction and distance from the radar site. As its name implies, the PPI tube makes a map of the area in a circle around the location of the radar set.

High-powered microwave radar sets can detect precipitation over distances of several hundred miles. The optimum useful range from the radar station is about 200 miles. This is due to the fact that the radar signals travel in essentially straight lines. The curvature of the earth results in the radar signals being about 5,000 feet above the surface at a range of 100 miles and about 20,000 feet at a range of 200 miles.

The significant contribution of radar as an observation instrument is that the entire precipitation pattern within the useful range of the radar can be seen at once and that the movement and change of the precipitation areas can be continuously observed. This means that storms such as hurricanes, squall lines, and thunderstorms can be watched continuously and their rate of movement determined.

Fine detail of precipitation patterns are displayed which can never be obtained by the plotting of synoptic weather maps because of the limited number of surface reporting stations.

Many significant weather events which occur between regular weather stations can be detected and help the meteorologist in making a more accurate forecast.

Theoretical studies of the relation of the amplitude of the radar echo from rainfall indicated a relationship to the drop size and number. Other investigators found that there was a relationship between the drop size and distribution of drops to the rainfall intensity. Combining the results of these investigators led to the idea of using radar as an instrument for measuring rainfall.

The significance of this development is evident to anyone who has ever worked on the problem of flood control, run-off, drainage, and storm-sewer construction. The wide spacing of rain gages cannot provide the detailed information required in many cases. This is particularly true in regions where rainfalls of cloudburst proportions can occur in a thunderstorm over a relatively small area.

During the summer of 1948, the University of Florida furnished five members of its Weather Radar Research group for a special investigation requested by the Air Forces at the All Weather Flying Center, Wilmington, Ohio. This study was concerned with the measurement of rainfall intensity by radar. Two radar sets were modified and placed in operation for the collection of data. The data secured by the U. S. Weather Bureau from their extensive network of weather stations in the Wilmington area were used for correlation.

The study revealed that there was significant correlation between the radar echo from a rain area and the rain intensity. A report on this investigation was presented to the annual meeting of the American Geophysical Union in April 1949, and was published in the *Bulletin of the American Meteorological Society,* October 1951.

Of particular interest at the University of Florida has been the application of radar to hurricane location and tracking. Florida and the islands of the Caribbean area lie in the region in which hurricanes occur frequently. Since at the present time there is no method for dissipating these storms, the best defense is adequate warning coupled with storm-proof protection. Fortunately the storm warning service has been very effective. The use of radar has materially improved the effectiveness of this service. Normally when a storm is not threatening any coast, aerial reconnaissance weather flights are made into the storm twice during the daylight hours. When a storm threatens a coast, radar-equipped aircraft keep surveillance on the storm. Ground-based radars are coming into greater use for this service. Their advantage is evident since they are more readily maintained, are not limited in size or power, and are capable of being more accurately calibrated.

The equipment used by the University's Weather Radar Laboratory is a micro-wave radar, capable or radiating 10-centimeter wave length signals at a peak power level of 750 kilowatts. The maximum range is 200

miles. Data recording is accomplished by photographing the image on the PPI scope with an automatic camera. Photographs can be made at various time intervals—normally at 30-second intervals. Since these photographs are standard 35 mm. movie frame size, they are readily projected in a motion picture projector. This effectively multiplies time so that an event which took several hours to transpire can be viewed in a few minutes. Considerable information as to the movement of weather can be obtained by viewing the recorded data in this manner.

FIGURE 4.—Hurricane seen on radarscope, August 27, 1949. A map of Florida has been superimposed to show the relationship of the storm to the land areas. The "eye" of the storm is clearly indicated at 100 miles, bearing 175°. (Concentric range circles are at 20-mile intervals.)

Radar observations have been made by the University of Florida of five hurricanes or tropical cyclones. The first important storm viewed occurred during August 1949. This storm developed northeast of St. Martin, Leeward Islands; passed within 100 miles of Puerto Rico; and entered Florida about 25 miles north of Miami.

This storm moved in a northwesterly direction over the State of Florida until the center just reached the Gulf of Mexico north of Tampa, Fla. At this point it turned northward, re-entering Florida and passing approximately 36 miles west of Gainesville. By this time its force was much diminished. The storm center continued northward into Georgia where it finally died.

Radar observations were started long before the storm came into the range. (At the time of this storm the equipment had not been modified and the maximum range was only 120 miles.) Operation of the equipment was continued during the entire period that the storm was within range of the equipment.

Over 2,500 individual pictures were taken of the radarscope during the period of observation. Since these pictures were made at set time intervals, they could be projected as a motion picture. This is the familiar "time-lapse" technique which has been used to show growing plants. This method effectively speeds up time about a hundredfold and shows clearly the rotation of the storm about the open center or "eye."

During 1950 there were three tropical storms which came within range of the radar equipment at the University of Florida. One of these was a severe hurricane, and

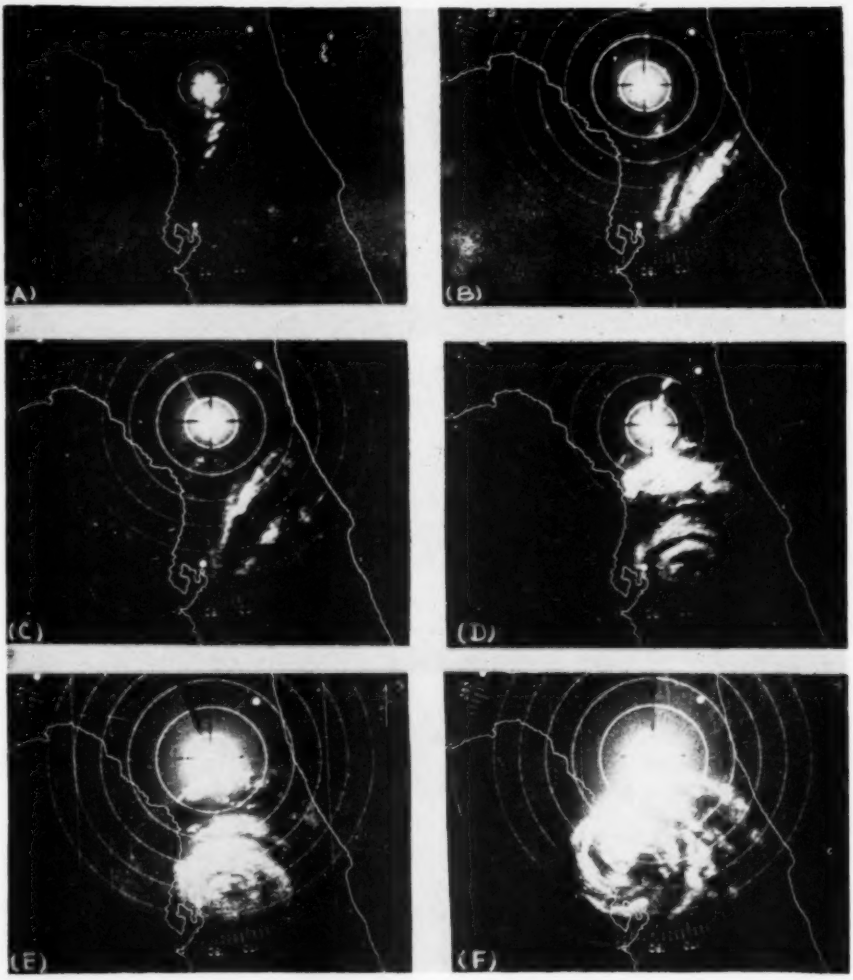

FIGURE 5.—Sequence of radarscope photographs showing the movement of the August 1949 hurricane.

(A) 8:45 p. m., Aug. 26. Characteristic squall line ahead of the storm proper. The outer edge of the storm is just coming into range at 120 miles, azimuth 152°.

(B) 10:15 p. m., Aug. 26. Outer precipitation bands, typical of hurricanes, have moved well into range.

(C) 11:00 p. m., Aug. 26. Hurricane rain bands have rotated farther to the west.

(D) 5.00 a. m., Aug. 27. The "eye" of the storm is now completely visible on the radarscope at 115 miles, azimuth 172°.

(E) 6:30 a. m., Aug. 27. Storm continues its northwest movement with center now at 100 miles, azimuth 176°.

(F) 9:30 a. m., Aug. 27. Near the West Coast of Florida, storm spreads out. Center is now at 86 miles, azimuth 198°.

was characterized by its erratic movements. Located initially south of the Isle of Pines on September 1, it moved northward slowly until it had crossed Cuba. Then the storm moved rapidly northward off the west coast of Florida until it reached a point about 50 miles west of Tampa. Here it remained almost stationary as it executed a small counter-clockwise loop. It then moved northeastward to the coast of Florida where it again stalled and made another small loop. This time it stopped right at Cedar Key, Fla., and that community had over 12 hours of hurricane winds. It then moved southward curving to the east and finally, much dissipated, moved north again.

This storm was first seen on the radarscope at the University of Florida when it was approximately 120 miles away. Regular reports were furnished the U. S. Weather Bureau of the location of the center. This information was vital, for this area of the Florida Coast is not densely settled, and surface reports were sparse. Areas affected by the storm were unable to communicate with other locations since the wire circuits were soon destroyed.

After this storm, the accuracy of the positions of the storm center determined by the University of Florida radar were compared with those obtained by U. S. Navy Hurricane Hunter planes. The greatest difference in position was only 13 miles. There was no way of ascertaining which of the two positions was actually more nearly correct. Another factor which probably accounts for some of the small differences is the fact that the diameter of the calm center was 25 miles. It is interesting to note that the difference in positions decreased as the storm moved nearer to the coast which permitted the plane navigator to obtain more accurate fixes.

During October a small intense storm moved over Miami, Fla. This storm caused considerable damage in the Miami area. When it came within radar range it had changed greatly in structure. The strongest winds were well ahead of the low-pressure center and below hurricane force. Photographs of the radarscope of the U. S. Navy ground-based radar at Key West show this storm to be very small in diameter (about 20 miles). When the storm reached the Orlando, Fla., area the intense central core had completely collapsed, with little, if any, precipitation in the central area.

FIGURE 6.—The University of Florida Weather Radar Laboratory and 120-foot radar tower.

A storm in the Gulf of Mexico late in October 1952 threatened the Florida west

coast. Conditions which forced cool dry air into the storm caused it to lose its force. Typical spiral bands were observed on the radarscope, but these deteriorated into undefined patterns as the storm decayed.

During the 1951 hurricane season, fortunately, no storms disturbed the weather of Florida. During August 1952, a hurricane moved near the Florida coast, threatening the Jacksonville area. The center of this storm never moved nearer than about 180 miles of the radar station and no well-defined center could be ascertained. From reports of the Navy aerial reconnaissance planes, this storm did not form a strong central core until just before it crossed the coast of South Carolina.

The emphasis at the University of Florida has not been on tropical storms alone. A great amount of data has been recorded of many other types of weather. Examination of these data have indicated many weather patterns not evident from the synoptic weather maps.

Many records have been obtained of the precipitation patterns accompanying cold fronts, warm fronts, squall lines, thermal convergence, and thunderstorms. One new study is the investigation of the origin of tornadoes. There is an extensive program in progress under the direction of the U. S. Weather Bureau in the Midwest "tornado belt." The occurrence of tornadoes in Florida is fortunately infrequent. One radar record was made of a tornado approximately 70 miles from the station. This radar record was used by research workers of the U. S. Weather Bureau to check their theories of tornado generating conditions.

The program for weather observation by radar is being expanded by the U. S. Weather Bureau. Weather offices in various parts of the United States are being equipped with radar units. The University of Florida has improved its facilities greatly by relocating the radar equipment on a 120-foot tower and by the construction of a laboratory building.

The electronic research programs at the University and at many other research centers throughout the world have brought forth many new developments for the benefit of mankind. It is gratifying to note that even these developments which were originally intended for military use have been converted to everyday peaceful uses.

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Training African Land Surveyors in Uganda

Land Survey in Uganda is an acute problem, especially in Buganda, the central kingdom. The vast proportion of the land is reserved for African ownership, but owing to its constant subdivision among the ever-increasing population, most of the present holdings are not only very small (about a couple of acres) but their boundaries are vague. At the beginning of this year some 20,000 plots of land were unsurveyed and the number was increasing faster than surveys could be completed.

To help meet the need the Uganda government is developing, as fast as is practicable, a Survey Training School for Africans. Established near Entebbe toward the end of the War, with 10 students, it now has nearly 50 trainees and has provided the Government Survey, Land and Mines Department, with some 80 new staff members, earning up to £450 a year. About a score of new students are enrolled in the School every year, and are given allowances to cover their cost of living and other personal needs; but only three out of four are able to stay the course, which is lengthy and calls for a high degree of intelligence.

The course for both surveyors and computers (the men who check at headquarters the results obtained by the field staff) lasts five years. A draughtsman's course lasts three years, and there are shorter courses for chainmen (surveyor's assistants). One of the graduates of the school —the first African surveyor in East Africa to be awarded a scholarship to England—is going to the School of Military Survey at Newbury.— *The New Commonwealth,* Nov. 10, 1952. London, England.

What Time Is It?

By ALFRED D. SOLLINS

U. S. COAST AND GEODETIC SURVEY

TUNE your short-wave radio to 5, 10, or 15 megacyles at any time of the day or night, and you can literally listen to the ticking of time, presented through the courtesy of the National Bureau of Standards. Each tick represents a second of mean solar time, the kind of time all of us would like our watches to keep. Each minute is marked by skipping the 59th tick, and every five minutes the Eastern Standard Time of the following minute is announced by voice and telegraphic code.

This finished product has been developed by the cooperative efforts of astronomers and physicists pooling knowledge gained over more than 300 years. The astonomer comes into this story because the earth, turning on its axis and circling the sun, has been the most faithful and accurate clock known to man; the physicist entered first as a clockmaker, and lately as a specialist in electronics.

In this country, it is the responsibility of the U. S. Naval Observatory to provide an accurate time service. Whenever weather conditions permit, astronomers of this organization observe the passage of stars across the meridian of the observatory. Originally they used the meridian transit, but that conventional instrument has now been superseded by the photographic zenith tube. From these observations, they compute corrections to the times shown by a battery of clocks, which, when corrected, show sidereal or star time. From long series of observations on the sun and the planets it is then possible to reduce sidereal time to mean solar time.

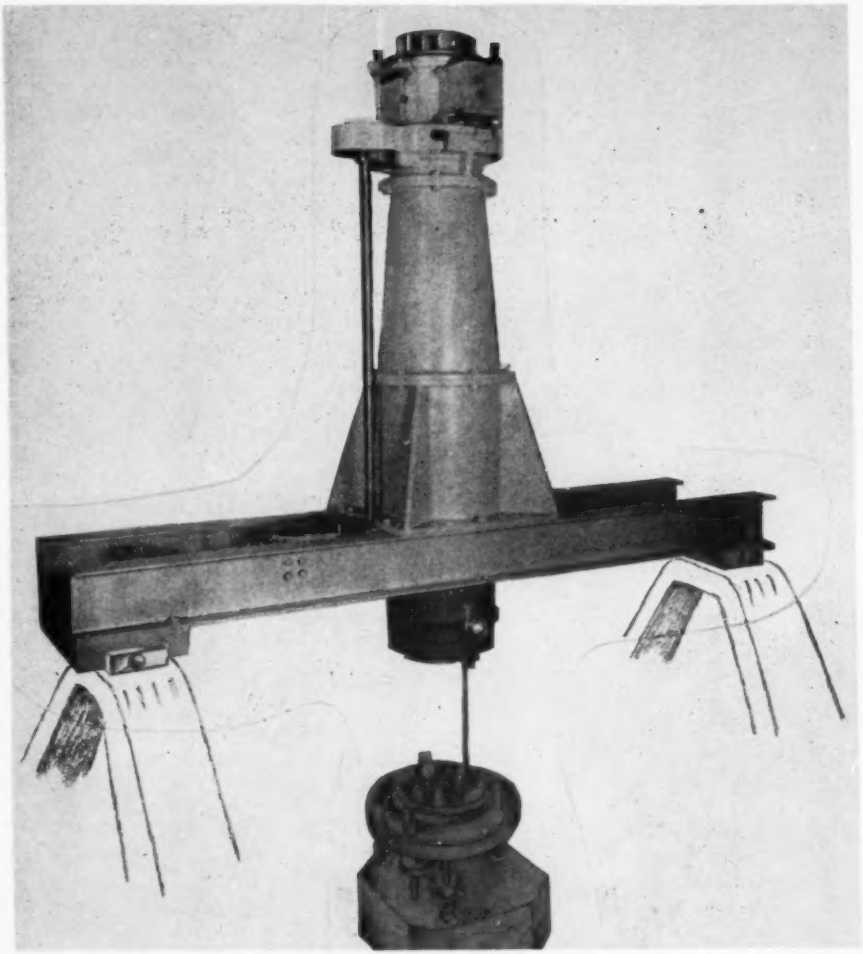
Mean solar time has no counterpart in nature. It was devised by man so as to be more uniform than apparent solar time, which is shown by a sun dial, and yet still to be in average agreement with apparent solar time over the course of a year. The non-uniformity of apparent solar time is produced almost entirely by two factors. First, the earth's orbit around the sun is not a circle but an ellipse, so in accordance with Kepler's second law the earth speeds up in its orbital motion when it is nearer the sun and slows down when it is farther from the sun. Second, the plane of the orbit is inclined to the equatorial plane of the earth, so that even if the orbital speed were constant, the sun would come to the meridian alternately early and late in each quarter of the year reckoning the quarters from March 21.

Until quite recently, the clocks used by observatories were pendulum clocks, the most accurate type a "free pendulum" controlling a "slave clock" but in turn receiving a friction-overcoming impulse from the slave every 30 seconds. The pendulum clock has now been superseded by the quartz crystal oscillator whose precision, for short periods, surpasses that of the earth itself. In fact, comparisons of batteries of quartz clocks with star time have shown with considerable certainty that the rate of rotation of the earth has a slight seasonal variation. An even better clock, the "atomic clock," which depends upon atomic vibration within the molecule, is in the process of development.

Years ago, the users of precise time relied upon the transport of chronometers and later, upon telegraphy. Since about 1920, though, there have been available radio broadcasts of precise time.

At present, there are three stations in the United States which broadcast time signals. Station NSS, Washington, D. C., broadcasts for five minutes preceding each even hour G.C.T.[1] on frequencies in kilocycles of 122, 4,390, 9,425, 12,630, 17,000, and 21,960. Station NPG, San Francisco, broadcasts for five minutes preceding 3, 8, and 15 hours G.C.T. on frequencies of 115, 9,255, and

[1] Greenwich Civil Time—Eastern Standard Time plus 5 hours.



(*Courtesy U. S. Navy*)

Photographic zenith tube at Richmond, Fla.

12,540 kilocycles. Three additional broadcasts emanate from this station at 17, 20, and 24 hours G.C.T. but only on the 115 kilocycle frequency. The reception of signals from either of these stations requires a code receiver because the transmission is in the form of a continuous wave. The third station in the United States is WWV, Washington, D. C., which transmits time signals twenty-four hours a day on frequencies in megacycles of 2.5, 5, 10, 15, 20, and 25. These are modulated signals and may be received with an ordinary short-wave set.

When the highest precision is required, it is necessary to consult the bi-weekly time signal correction sheets prepared by the

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Naval Observatory. These sheets show the failure of the radio signals, as received in Washington, to agree with their nominal times. For NSS and WWV, these errors are usually less than 0.^{s}02, for NPG they are less than 0.^{s}1. Again for the highest precision, a correction is needed for the time of radio transmission to the field station.

The developments in timekeeping so briefly sketched here, culminating in the continuous time service available through WWV, make it possible for scientist, surveyor, or engineer to have time itself at his beck and call.

Army Engineers Develop Labs on Wheels

Laboratory facilities will be available to Army engineers in the field if mobile units designed by the Engineer Research and Development Laboratories, Fort Belvoir, Va., pass stiff qualification tests.

With the accent on mobility, Fort Belvoir engineers have developed truck- and semi-trailer-mounted laboratories which will traverse rough terrain to bring on-the-spot functional and maintenance apparatus to units operating in forward areas.

Included among the numerous items undergoing rigid engineering and service tests are a materials laboratory, a cleaning and preservation unit, a photomapping train for topographic organizations, and five maintenance shops.

The motorized photomapping equipment train consists of a series of van-type trucks with expansible sides. The vans, which are capable of expansion by two men in only five minutes, contain equipment and facilities for computing, plotting, drafting, editing, copying, supply, and mosaic compilation operations of Army topographic units in the field. Each van provides a 17- by 13½-foot working area and can be air-conditioned and heated.

The Road Maps of the Seas

By GUILLERMO MEDINA

CHIEF ENGINEER, U. S. NAVY HYDROGRAPHIC OFFICE

DESPITE the advances made in the fields of transportation during the past fifty years, ships still provide the most economical means of linking the markets of the world. This situation results from the fact that 70 percent of our planet is covered by water and that the cost per ton-mile by ship is a fraction of that by the next cheapest type of transportation.

The era of exploration which followed Columbus' discovery of the New World established the nautical chart not only as a tool of navigation, but also as the most authoritative document of those days in claiming right of possession to land area scattered throughout the seven seas. Nautical charts have, in fact, recorded for history the political evolution of the past four and a half centuries. They, too, have served to unfold gradually the panorama that lies hidden beneath the surface of the sea.

It is a credit to our explorers and hydrographers of the past—and to the cartographers who recorded their permanent contributions to the field of geography—that despite the limitations of their equipment and the inaccuracy of their chronometers they were able to chart the coastlines of the world with such relative accuracy and so much detail. Although the delineation of the coasts was far from perfect, isolated rocks, banks, shoals, and other dangers to navigation discovered in their voyages were adequately portrayed on the charts. Even today we refer to those early documents, in planning and conducting modern hydrographic surveys of heretofore undeveloped areas. In my surveying days in Cuba, Venezuela, Colombia, and Panama, I had occasion to verify the thoroughness of the hydrographers of long ago.

Presented at the Thirteenth Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 23–25, 1953.

A REVOLUTION IN CHARTING TECHNIQUES

In thirty years of service with the U. S. Navy Hydrographic Office, I have witnessed a revolution in surveying and charting techniques. The old faithful steaming launch, the hand lead for taking soundings, the planetable, the repeating theodolite, the broken-back transit for astronomical observation, the single-type observing tower, and many other types of instrumentation and techniques have been replaced in many instances by equipment and procedures of much greater accuracy, greater portability, greater range, and greater ease of operation. In fact I envy the surveyor of today when I see the equipment he has at his disposal, while yet experiencing the adventure that is always associated with surveying, whether on land or at sea. Today he has the airplane to record in detail, and in advance of actual operations, every inch of the terrain so that he can plan the entire conduct of the survey. From preliminary plots and the actual photographs he can tentatively select the location of base lines, location of triangulation points with relation to accessibility and intervisibility, tide gage sites, and the entire signaling scheme for controlling the hydrographic operations. The mother ship has many of the comforts of home, adequate quarters and facilities for drafting and computing, and, in the case of our Navy survey vessels, complete photogrammetric and reproduction facilities. At his disposal, the surveyor has a helicopter for reconnaissance, for transportation of personnel and equipment to areas of difficult access, and for supplemental photography. He no longer has to make laboriously detailed sketches of signal locations, as vertical or oblique aerial photographs provide infinitely more detail.

What about the sounding and positioning equipment? The echo sounder and electronics have taken over, giving us the op-

(*Official U. S. Navy Photo*)
The helicopter is of inestimable value in expediting the transportation of survey personnel and materiel.

portunity to carry out hydrographic operations at practically all times regardless of visibility. Instead of stopping at the continental shelf as we did in the old days, our work now covers the oceanic areas.

It was my original plan in preparing this paper to delve at some length into the matter of submarine topography, to bring out the fact that the age of exploration is not over—at least not for those who are engaged in the fields of hydrography and oceanography. However, after reading Lincoln Barnett's article in the Feb. 9, 1953, issue of *Life Magazine,* I decided to give up the idea. I feel sure that for all time it will be very difficult to equal this great masterpiece of poetry in prose on what is truly "The Miracle of the Sea." The factual data contained in that beautifully illustrated article will serve to stimulate our efforts in this field of exploration. I can assure you that both the U. S. Coast and Geodetic Survey and the U. S. Navy Hydrographic Office have contributed in large measure to our knowledge of the oceans.

WHY CHART THE SEAS?

Some of you may wonder why we go to all the trouble of charting the seas with so much detail; why bother to depict, by soundings or bathymetric curves, that which we don't see? Why be so particular in the matter of topographic and hydrographic portrayal?

The reasons are more or less similar to those which have made it necessary to produce more accurate and more detailed topographic maps and aeronautical charts. Bigger and faster ships, and the need for providing maximum safety to navigation have necessitated not only more accurate and more detailed surveys but also improved positioning methods. In fog and when inclement weather has prevented the usual astronomical observations, a vessel can make a safe approach either by soundings or electronic positioning means or by a combination thereof. Regardless of which type of electronic positioning equipment is used, the accuracy is dependent on the position of the electronic stations and, in the case of radar, on the accurate portrayal of the terrain and all man-made features.

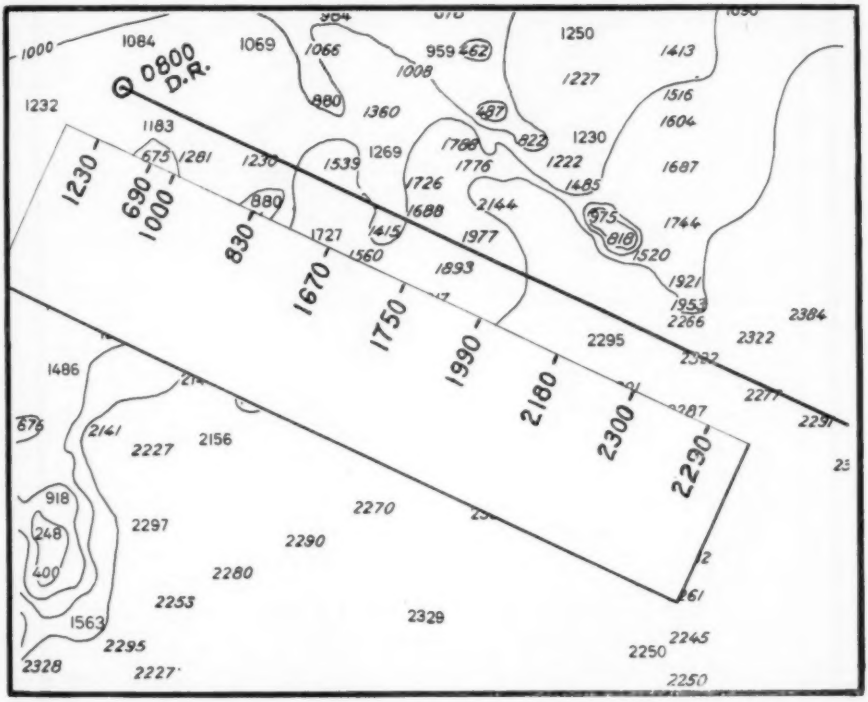
The same relative accuracy is necessary for navigation by soundings. The profile of the bottom obtained by the sonic depth finder—oriented to the true course of the vessel—provides a relatively accurate position, particularly when the submarine topography is of a rugged nature.

MAINTAINING NAUTICAL CHARTS

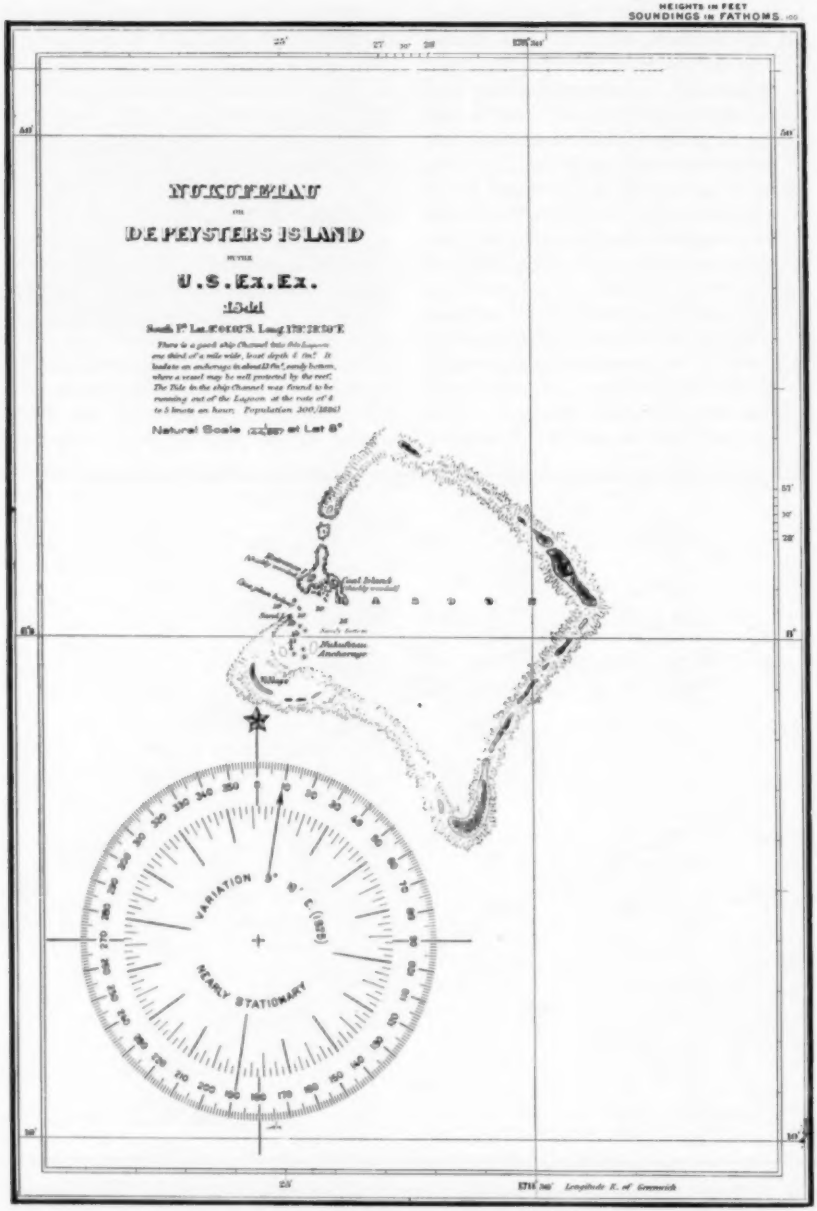
A nautical chart is a navigational tool whose precision depends on constant maintenance. No matter how accurate the original survey may be, or how thorough the work of the cartographer, a nautical chart is placed in maintenance the instant it is printed.

Why is this necessary? We don't correct topographic maps until a new edition is to be printed and no corrective source is provided to maintain them in an up-to-date condition. Don't both portray a portion of the earth's surface? The principal difference between the two, however, lies in the fact that the road maps of the seas do not show sign posts to lead us to our destinations. Our positions, unless obtained by astronomical means, depend on measurements from points of reference whose characteristics or locations are often subject to change. A channel into a harbor may change practi-

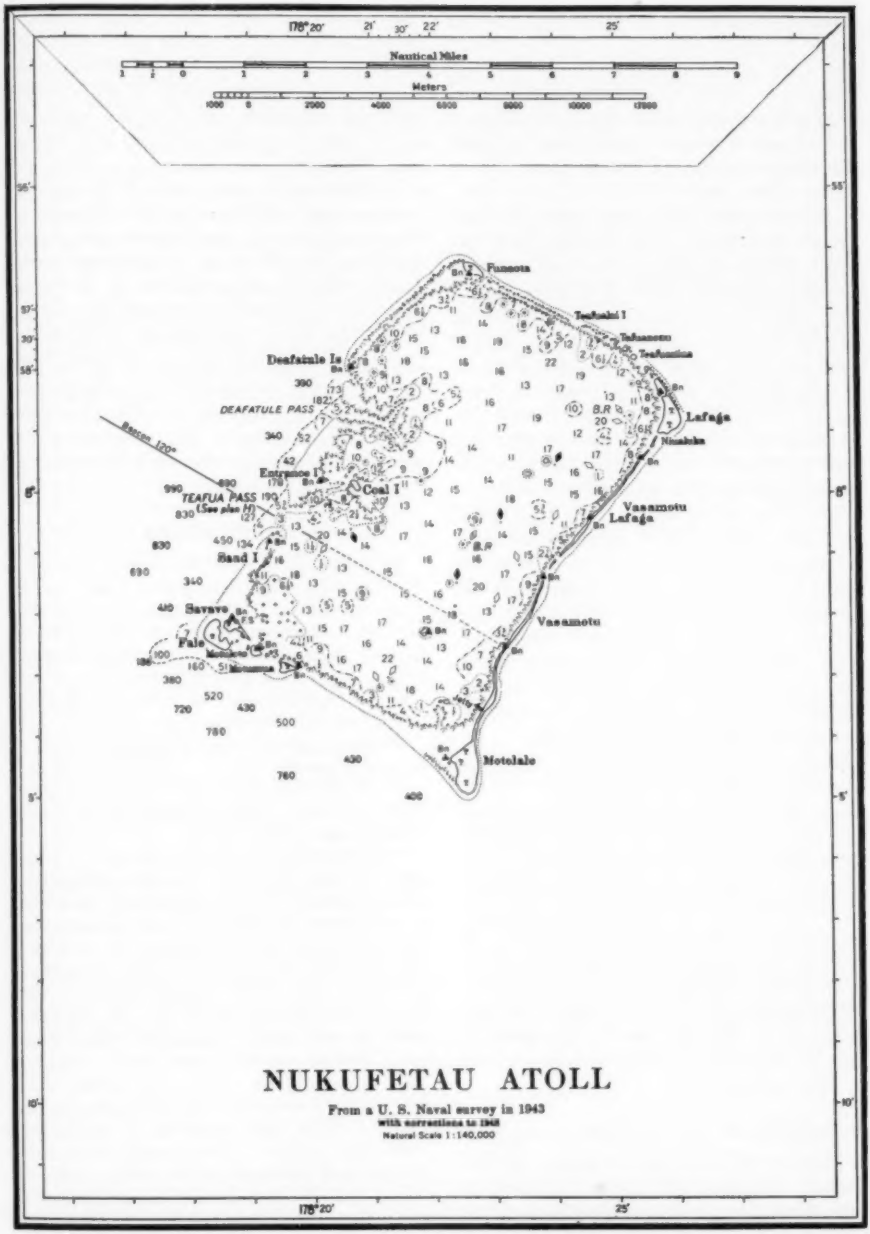
cally overnight. A new light may be established, the location, shape, or light characteristics of a buoy may be changed, a new jetty constructed, a submarine cable may be laid. There are a great many things occurring in an area which can render the chart dangerous unless each and every one of them is accurately incorporated on it. How is it possible to provide such a timely corrective service for the thousands of nautical charts in use or in stock? Our Office, in collaboration with the U. S. Coast Guard and the other hydrographic services throughout the world that exchange information with us on a continuing basis, publishes each week a most unique bulletin known as the *Notice to Mariners.* This *Notice* is published in two parts: one for the Western Hemisphere and the other for the Eastern Hemisphere. It contains complete and authoritative information for the correction of each chart or publication affected. In addition, the Hydrographic Office prepares two daily broadcasts on all such items which will be embodied in the next *Notice to Mariners* which are considered of paramount and immediate importance to safety at sea. Under maritime regulations it is the responsibility of the Captain or Master of a vessel to see that such information, promulgated by the hydrographic services, is incorporated immediately on the charts in use. Likewise, the stocks on hand produced and distributed either by the Coast and Geodetic Survey or by the Hydrographic Office must be kept corrected to



A strip of paper on which observed soundings have been laid off to scale can be used to correct a dead-reckoning track over irregular bottom if sufficient soundings or fathom curves appear on the chart. Here, this method reveals that the D. R. track is too far north, and the 0800 position can be adjusted accordingly.


HEIGHTS IN FEET
SOUNDINGS IN FATHOMS
NUKUFETAU
OR
DE PEYSTERS ISLAND
SURVEYED BY THE
U.S. Ex. Ex.
1841
South Pt Lat 8°00'S. Long 178°28'30"E
There is a good ship Channel into the Lagoon one third of a mile wide, least depth 6 fms. It leads to an anchorage in about 12 fms, sandy bottom, where a vessel may be well protected by the reef. The Tide in the ship Channel was found to be running out of the Lagoon at the rate of 4 to 5 knots an hour. Population 300 (1841)
Natural Scale at Lat 8°
Coral Islands
Nukufetau Anchorage
VARIATION 9° 0' E (1839)
NEARLY STATIONARY
Longitude E. of Greenwich

This was the only chart of Nukufetau available prior to the survey by the USS *Sumner* (AGS-5) in 1943.



The new chart of Nukufetau reveals obvious changes and additions resulting from the survey.

date of issue. Such corrections are normally made by hand. Should the correction be too large or complex, use is made of a chartlet or poster. This consists of a small chartlet published in the *Notice to Mariners* for the area in question embodying the latest information, which is pasted over the affected chart.

This frequent correction service imposes certain problems on the hydrographic services. Unlike a topographic map, a nautical chart cannot be stocked in large quantities. Smaller and more frequent printings are found to be more economical. This in turn requires more frequent handling of the lithographic plates and makes it necessary to have the base negative under frequent maintenance. In order to maintain both the stock of charts and the lithographic plates in an up-to-date condition, a master copy of the chart printed on a translucent medium is kept current from the latest information. From this master or standard copy, one-color photo-chemical proofs are produced for the guidance of the chart correctors and the lithographic draftsmen. This not only insures cartographic agreement in the correction and production system but insures a greater state of readiness to meet unforeseen printing demands.

Inasmuch as a nautical chart must portray topography and hydrography and because tides, currents, magnetic variations, and aids to navigation must all be integrated in its design, it is necessary for the chart compiler to have a very broad knowledge of the entire field of cartography. He must be versed in map and chart projections. In addition he must be thoroughly versed in hydrographic, topographic, and aeronautical symbolization. If he is engaged in compiling from foreign sources, he must be able to interpret readily the symbols used by other nations.

COOPERATING FOR MAXIMUM SAFETY

That is why the International Hydrographic Bureau has been endeavoring throughout the years to standardize the symbols used on nautical charts, for it is not only of help to the mariner but to the compiler as well. In this connection, the Bureau should be congratulated for its initiative in inviting to the International Hydrographic Conferences representatives of other international mapping organizations such as ICAO, the International Union of Geodesy and Geophysics, and others.

We have made great strides in the design, construction, and reproduction of nautical charts. United by common interests—the principal one of which is providing maximum safety to navigation—the U. S. Coast and Geodetic Survey and the Hydrographic Office are giving the United States Navy and the Mercantile Marine the most efficient service in the world at a minimum cost to the taxpayer. In fact it is the most economical type of service that our country can provide to insure the efficacy of its maritime commerce and defense.

DISCUSSION

PRESIDENT STUDDS: Thank you, Mr. Medina, for a most authoritative exposition of a nautical chart in hydrography. I think Mr. Medina is somewhat modest when he speaks of his some thirty years service in the Hydrographic Office, because the accomplishments he recites are in a large measure the results of his time and efforts and endeavors.

We have a few minutes for discussion, if there are any questions.

CAPTAIN GIUDICE (Italian Hydrographic Office): I have three questions on three different points of your paper.

First, speaking of modern Navy survey vessels, you said that they have complete photogrammetric facilities. I am particularly interested in this subject because our new hydrographic ship will be put into commission very soon and she will have to operate not only in Italian waters, but also in the Indian Ocean for the purpose of keeping up-to-date our nautical charts of the Italian Somaliland which were made after the survey of 1937–38–39. Do you think that this ship, which will operate very far from the homeland, should have photogrammetric facilities, and what types of equipment would you suggest? You certainly know that Italy is well advanced in the field of photogrammetry. We have good Italian-made equipment; that was certainly demonstrated at the last meeting of the International Society of Photogrammetry. Have you seen any appara-

tus, among those exhibited by the two main Italian firms, Nistri and Santoni, which could be considered similar to the apparatus you use on your survey vessels?

My second question concerns the charting of the Somaliland waters, but before asking it, I would like to state that I am not only an old hydrographer, but also an old seaman, and I would like to join you in stressing the importance of a detailed charting of submarine topography, not limited to the coastal waters but covering the whole of the open seas. In time of war, on more than one occasion, I could make a safe approach among mine fields, when the weather conditions prevented astronomical observations and radio bearings were not reliable, only by soundings, taking advantage of the rugged and well-charted submarine topography of the Atlantic French coast. As you said, a good survey of the bottom of the sea can be made by means of the echo sounder and electronic position finders. We are faced now with the problem of choosing a suitable positioning apparatus for our new survey ship. In this field we don't have, at least until now, a good Italian-made product and would like to purchase some American equipment. May I ask your recommendation about the best types of apparatus to be used in the two cases of short distance and long distance from the coast line?

My last question concerns the reproduction and correction of nautical charts. You referred to lithographic plates, but you probably also have or have had copper plates. In the case of the Italian Hydrographic Service, this is very important, because about 30 percent of our charts are printed from copper plates. We have been trying to get rid of the well known inconveniences of deformations and the long time required for the chalcographic printing. We have been trying for a long time to obtain lithographic plates through photographs of copper plates, until now with not very good success. We are still working at it, but certainly no one is in a better position than you to give me some valuable suggestions on the basis of your experience in the same field.

Table of Comparison—Electronic Positioning Systems

System	*Frequency*	*Range (in n.m.)*		*Probable Error (in n.m.) of Single Line of Position*	*Users*	*Stations*
		Day	*Night*			
Std. Loran	1750–1950 kc.	700	1400	0.1 on base line, 1 to 6 at limits	Unlim.	Fixed
Mobile Loran	1750–1950 kc.	400	1400	0.1 on base line, 1 to 6 at limits	Unlim.	Portable
Shoran	300 mc.	40	(7/4 line of sight)	30 to 40 feet	20	Portable
Std. Decca	70–130 kc.	300	75	10 feet on base line, 0.1 at limits	Unlim.	Fixed
			75–240	0.5 at limits		
Survey Decca	70–130 kc.	100 (?)	30	5 feet on base line, 200 feet at 100 mi.	Unlim.	Portable
EPI	2 mc.	500	100 (?)	60 to 100 feet	1	Portable
Raydist	2 mc.	70	50 (?)	3 feet on base line, 30 feet at limits	1	Portable
Lorac	2 mc.	130	55	3 feet on base line, 30 feet at limits	Unlim.	Portable
Consol	260–500 kc.	1500	25	0.1 at 25, 5 at 1500	Unlim.	Fixed
			350–500	Unusable 25 to 350, 5 at 500		

MR. MEDINA: Before answering Captain Giudice's questions I want to mention that the views contained in my paper and those that I am about to express are my own and do not necessarily reflect the opinions of the U. S. Navy Hydrographic Office.

As to your first question, Captain Giudice, the photogrammetric equipment on board a survey vessel should consist of only those items necessary to assist in the conduct of the survey. Conditions on board ship make it mandatory that this equipment be as simple and compact as possible. U. S. Naval survey expeditions normally carry the following equipment for or related to photogrammetric operations: stereoscopes, stereocomparagraphs, metal-arm radial plot assembly, reflecting projectors, camera transit (to reduce the amount of ground control), K–17 and K–20 cameras, and a photographic laboratory. We are considering the possibility of using KEK plotters on board as this will materially improve their capabilities for compilation by the utilization of contact prints.

With regard to the second question—electronic positioning systems used in hydrographic surveys,—it is difficult for me to suggest the best type of apparatus for short and long distances. There are quite a number of systems in use for survey purposes, of European or American design, each of which has advantages and disadvantages. Some are of the hyperbolic type which require lengthy computation for the accurate drawing of the curves, but which permit multiple ship operation. Ambiguity and lane identification can give you trouble at times. Others of the direct distance-measuring type are limited to one ship or involve time sharing if more than one vessel is in operation. A table of comparison, which will be published with this paper (*See* table on preceding page—Ed.), contains significant information on some of the systems most in use.

As to your third question, many services such as those of Italy, England, and France, and the U. S. Navy Hydrographic Office still have thousands of charts on copper—a priceless investment. I estimate the value in effort of our copper plates to be in the neighborhood of ten million dollars. No matter what advances are made in the art of chart construction we cannot discard this heavy investment. What we have done at the Hydrographic Office is to combine drafting techniques with copper plate impressions.

There are two or three ways of licking your problem. One way is by photographing the copper plate; the second way is by obtaining a stable plastic transfer utilizing a Swedish process, details of which can be furnished by the Norwegian Hydrographer; the third way is by employing a system developed by Captain Jensen, the Danish Hydrographer. Complete details of his method will be contained in a forthcoming issue of the International Hydrographic Review.

CAPTAIN GIUDICE: Thank you.

PRESIDENT STUDDS: Are there further questions?

MR. EDMONSTON (Coast and Geodetic Survey): You referred to the Maritime regulations requiring that all charts be kept up-to-date. Actually, the Code does not really say that in so many words. I am bringing it up at this time as I think it is very important that the Federal Code should have some regulation requiring mariners to keep their charts corrected at all times. In addition to that, the Federal Code should require the mariner to have the latest edition of the chart on board. There is no such regulation in existence. I feel it is very important to have the latest edition on board ship.

MR. MEDINA: Mr. Edmonston is correct on all counts. I have before me the latest rules and regulations promulgated by the U. S. Coast Guard. Paragraph 97.0521 deals with Notices to Mariners and Aids to Navigation. Licensed deck officers are required to acquaint themselves with the latest information published by the Coast Guard and the United States Navy regarding aids to navigation. Neglect to do so is evidence of neglect of duty. It is desirable that boats shall have available in pilot houses for the convenience of services at all times this *Notice to Mariners* and *Aids to Navigation*. In the matter of charts, all vessels other than motor boats shall have these charts convenient on vessels at all times. I agree that these regulations are too general and that they should be spelled out more fully for the protection of the people who sail the seas.

▼ ▼ ▼

FOURTEENTH ANNUAL MEETING, MARCH 22–24, 1954, WASH., D. C.

A Technique of Presenting Slope and Relative Relief on One Map

By FRANCIS E. ELLIOTT
U. S. NAVY HYDROGRAPHIC OFFICE

SLOPE and relative-relief maps have been accepted as tools of geographic research for some time. A relative-relief map is one that presents the difference in elevation between the highest and the lowest points within an area regardless of elevation above sea level. A slope map is one that presents the inclination of the land surface between points of different elevation, usually in degrees, percent, or mils. The history and a method of construction of relative-relief maps can be found in a paper by Guy-Harold Smith,[1] and various methods of making slope maps are described and documented by Erwin Raisz.[2]

Although it is true that these maps do not show anything that cannot be determined from a contour map—an objection that has been raised repeatedly—nevertheless they have the advantage of showing regional patterns that are not easily recognized from the contours. These patterns of slope and relief are the features one is interested in when making land-use studies, terrain studies, and so on. The relative importance of the two features changes with the type of study for which they are used. In an agricultural land-use study, slope will become the more pertinent feature, because one wants to know what use is made of various types of slope. In a terrain study, on the other hand, both features are equal because one wants to establish regions of equal ruggedness. In a physiographic study, relief will be the more important because one wants to express second-order forms such as plains, hills, or mountains; slope will give them a further breakdown, for instance into rugged or gentle hills. Contour maps give elevations above mean sea level, which in itself is a rather unstable reference plane, while the difference between the highest and lowest points in a certain area is a much more stable criterion. Furthermore, the relative relief usually concerns and interests the person who lives in an area more than his elevation above sea level.

The usual procedure in constructing these two types of maps is to plot them on separate sheets; in some cases one is made as an overlay. In the first instance the difficulty is in visualizing the topography of the area under investigation by looking alternately at the two maps and overlaying them mentally. In the other case, if the overlay is done on tracing paper a light table is needed to see clearly, and if the overlay is done on acetate there are technical difficulties in drafting inherent in this material.

The technique suggested here not only eliminates these difficulties but also simplifies the construction and thereby reduces the time element considerably because only one base map is needed. It is also of no importance which method of construction of either slope or relative-relief is used, and the individual may choose the one that fits his purposes best.

EXPRESSION OF RELATIVE RELIEF

The author used a very simple method for the relative relief, attacking that problem first. His intention was not to make a relative-relief and slope map of the Charlottesville quadrangle for its own sake—the area was chosen at random—but primarily to demonstrate the technique of presenting both

The writer is indebted to Drs. Erwin Raisz, Louis O. Quam, and Samuel Van Valkenburg, as well as to Richard Edes Harrison, for criticism and suggestions.

[1] SMITH, G. H.: "The Relative Relief of Ohio," *Geog. Rev.*, v. 25, pp. 272–284, 1935.

[2] RAISZ, E.: *General Cartography*, New York, 1938.

FIGURE 1.—A slope and relative-relief map.

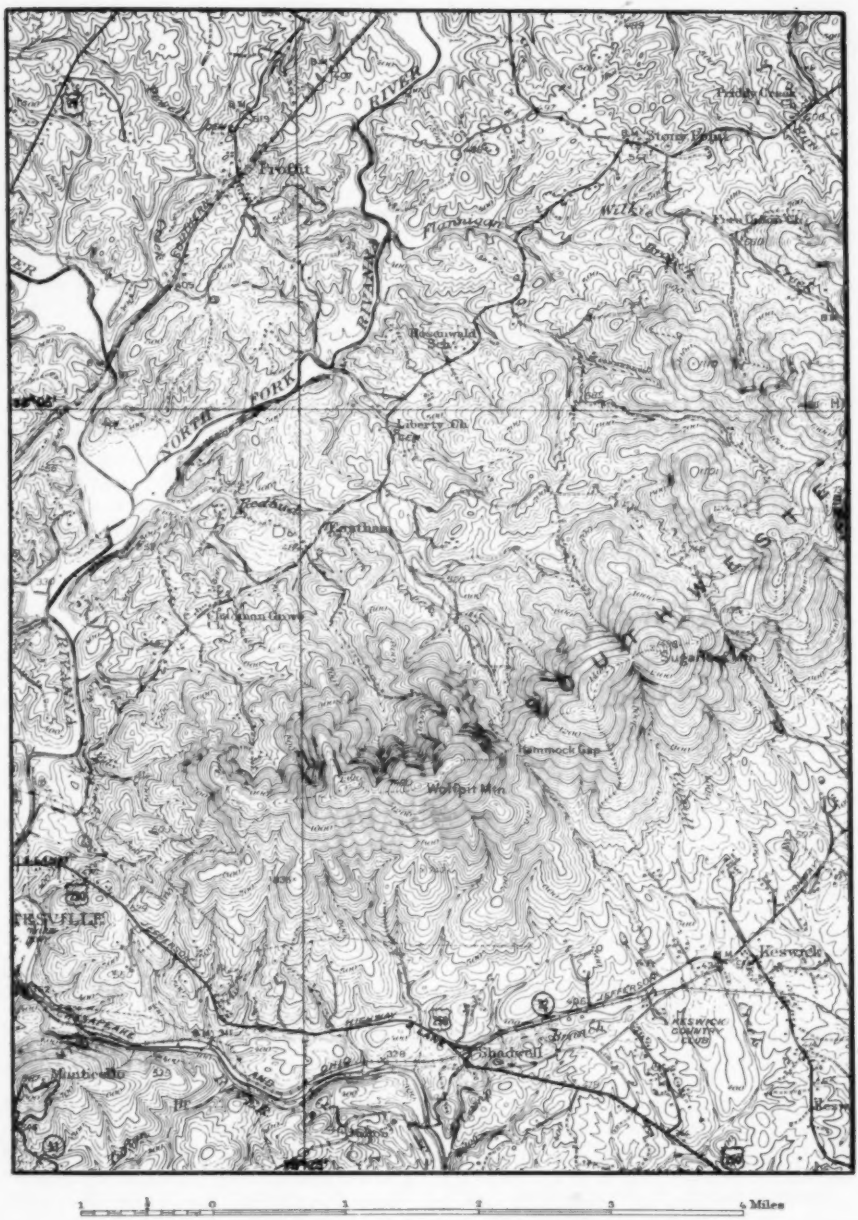


FIGURE 2.—A portion of the Charlottesville quadrangle.

on one map. Therefore it was decided to make a somewhat generalized map. A 2½-minute grid was used, because by trial and error it was learned that a very detailed map would have defeated the stated purpose by becoming too complex. The progression of the relief categories was decided upon from the same point of view. This does not mean, however, that the technique will not work in small details. The author has tried a 30-second grid and 50-foot relief categories, and with the proper amount of care the results were quite satisfactory though too detailed to permit reduction for publication.

Deciding upon the size of the grid and the breakdown of the relief categories are the two most important steps, because on these decisions will depend the amount of detail the map will show and whether it will be more generalized in the areas of low, medium, or high relief. Both decisions depend also on the scale of the map and the topography of the area to be investigated. A large-scale map will permit a small grid and a detailed breakdown, whereas on a small-scale map a larger grid and a more generalized breakdown will have to be used. In a relatively flat area a detailed breakdown should be used because otherwise the whole area will fall into one category; in a mountainous area a wider breakdown will do.

After the size of the grid and the relief categories were determined, the topographic sheet was inspected by overlaying the grid which had been drawn on acetate. In each square the difference in elevation was determined and boundaries drawn on the topographic sheet around areas falling into the same relief category. In cases where one part of the square fell into one category but the rest into another, the boundary was drawn through the square where the "break" in relief was shown on the base map. (This method is somewhat different from the one suggested by G. H. Smith, but the writer believes that it is preferable in most cases because the "breaks" in nature do not follow a predetermined grid; this results in a more natural regional pattern, something that Smith's mathematical procedure fails to do. It is conceded, however, that it is more subjective than Smith's method.) After the boundaries were drawn, the relief regions were colored in different tints, for easier recognition in subsequent tracing.

EXPRESSION OF SLOPE

In order to make the slope map, first the slope categories were selected from the same point of view as had been used for the relief categories; that is, they were chosen wide enough to permit reduction but still small enough to express the character of the topography. Then by simple arithmetic the distance between the 100-foot contours was calculated to the scale of the map in order to represent the predetermined slope categories. For example, setting a pair of dividers at the distance between 100-foot contours for a 5 percent slope, it was simple to delineate that category. Wherever the 100-foot coutour interval was wider than the distance in the dividers, the slope was less than 5 percent; wherever narrower, the slope was over 5 percent. The other categories were treated in the same manner and boundaries were drawn on the relief map around areas belonging to the same slope category. The slope categories were then shaded in black, always on the same topographic sheet, and eventually the finished product was traced on tracing paper.

In other words, the slope map is superimposed on the relative-relief map, and although the boundaries of the relief and slope categories have been arrived at independently, higher relative relief has to go with steeper slopes, which, with few exceptions, is also the case in nature. This is the important feature of this technique.

In figure 1, slope is shown in vertical shading and relative relief in horizontal shading. In order to emphasize the slope the vertical lines are drawn somewhat more heavily than the horizontal ones. Boundaries around slope and relative-relief regions are marked as dashed lines to remind the reader that they are not fixed by nature but by man, and represent narrow zones of transition rather than sharp lines.

If desired, the major drainage pattern

may be included; however it is not advisable on a black and white presentation because it tends to confuse the picture and reduce readability of the map.

READING THE MAP

Generally speaking, one might say that the Charlottesville quadrangle shows an average relative relief of from 100 feet to 250 feet and a slope between 0 percent and 5 percent, with some flat areas mostly in the flood plains of the rivers and creeks. Some parts of the valleys are comparatively steep-sided. A chain of fairly steep hills trending southwest to northeast is conspicuous in the southern part of the quadrangle. Beyond this chain there are only some isolated hills that rise above the general level and have a slope steeper than the average. This agrees quite well with the general concept of the Piedmont peneplain.

Figure 2 is presented so that the reader may compare the slope and relative relief map with the topographic sheet upon which it is based.

The writer has made numerous experiments with cross-hatching, dotting, and so on, and has found the vertical and horizontal shading to be the most effective means for a black and white representation. A more effective map, however, can be made by using colors for the relief categories and superimposing vertical shading for slope.

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Improved Techniques and Lower Costs

By PROF. ARTHUR J. McNAIR

HEAD OF SURVEYING DEPARTMENT, CORNELL UNIVERSITY, ITHACA, N. Y.

RECENTLY a man well known in the education field and in a position to observe and analyze current trends in engineering was visiting in my office. He came out with the blunt statement: "Surveying is dead! You may as well admit it! Dream up a new name! For sales appeal, something with a flashy title should be selected." He proposed a name which had a certain degree of merit, but I rebelled openly against the thought of dropping the words *survey, surveying,* and *surveyor,* and I feel that most people connected with surveying would do the same.

After all, surveying has its roots deep in antiquity. It is almost impossible to find a record of the history of mankind so early that there is not a record of surveying measurements at that time. With this historical tradition, it is inevitable that surveying, growing over thousands of years, should be a very broad subject touching many fields of endeavor. We need only to look at the existing six broad divisions of our own American Congress on Surveying and Mapping to realize something of the scope of surveying. Each division has many ramifications. Furthermore, there are other types of surveying which, for one reason or another, are not represented. It is possible for a man to spend all his life in but one of these fields and to have little contact with the other fields in surveying. This makes it possible for a man who is, after a manner of speaking, 'way out on a limb of the tree of knowledge to forget that there are other branches in addition to his own as well as the trunk or main stem. The surveyor should be proud of his heritage and rejoice in the understanding that he is contributing to a venerable profession but not be too proud to develop and adopt new techniques.

A man working by himself may even forget that he is dependent upon this figurative tree of knowledge. Worse yet, he may forget that it is his privilege to draw upon the supply of basic sciences and other stores of knowledge common to mankind. The surveyor should feel as free to "dip in" and use new materials, new methods, and new ideas from the common store as any other engineers or scientists. He is no more committed permanently to his present surveying equipment than was his predecessor of sixty years ago inexorably committed forever after to the sole use of the compass.

This brings us then to the consideration of instruments and the business of the Instruments Division of the American Congress on Surveying and Mapping. Even more specifically it brings us to a consideration of the title of this paper, "Improved Techniques and Lower Costs." Instruments always have been a prerequisite to surveying. For instance, for measuring distances the "rope stretchers" of Egypt are our professional forefathers. And, we might add, they really were considered as professional men since they held positions only slightly lower in rank than those held by the Pharoah and his family. More recent instruments for the measurement of distance include the chain, the steel tape, the micrometer, the invar tape, and now, most recently, electronic methods. Each of these instruments in turn has, of course, had many improvements made in its design and construction, though it may subsequently have been superseded by some newer method dependent upon an entirely different basic principle.

To develop a little further what we can learn about improved techniques and lower costs, let us follow the development of one type of surveying instruments; namely, those used for the measurement of angles. Some of the various instruments which have been used for measuring angles include the plane-

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table and alidade, the transit, theodolite, sextant, and compass with which we are all familiar. Instruments for measuring special angles include the optical square and the solar attachment. Of course we should not forget that a tape and set of tables of trigonometric functions also afford a satisfactory way of measuring angles in some cases, especially if the angles to be measured are very small. More recently the camera and specialized instruments to go with it, such as the transit-camera or the zenith camera have been used to measure angles. For setting off or for reading angular units, devices such as the vernier, graticule, gradienter, micrometer, micrometer-microscope, optical lever, comparison scale, and averaging scale are among those which have been developed.

Let us scan quickly the historical development of the more important instruments. The dioptra, built about 100 B. C., was apparently the earliest instrument of record which was similar to our own surveying instruments. This instrument was made of brass and consisted of a horizontal circle which was divided into 360 degrees. Since the telescope had not yet been developed, a peepsight was used for alignment and the instrument could be used in a manner similar to either that of a transit or of a planetable alidade. In an effort to increase the accuracy of these instruments, the circles were made larger. There is a record that Ptolemy about A. D. 130 used a dioptra which was 6 feet in diameter and made of polished stone divided into single minutes of arc. Of course such an instrument was used for astronomical observations rather than for purposes of making a land survey. It is doubtful if the improved technique of enlarging the circle actually lowered the cost in this instance.

The magnetic compass is another early instrument developed for measuring angles. Its principles were apparently discovered in China perhaps thousands of years ago. Its use in English-speaking countries began about A. D. 1200.

In 1571 an English mathematician and surveyor, Thomas Digges, restated the principal elements of the theodolite or transit. This has been called the beginning of modern surveying. In 1608 the telescope was invented. Immediately telescopes were applied to astronomical instruments and to surveying instruments. These two fields of study are still intimately related. In 1631 the principle of the vernier was described in a paper published by a Frenchman by the name of Vernier. About 1640 the method of placing crosshairs at the common focus of the lenses in a telescope was discovered. Thus a definite line of collimation in telescopes was established. It is interesting to note that the first crosshairs were made of silk and that for the next 150 years or more, silk, silver wires, and etched lines on either glass or mica were used. For the next 125 years, spiderweb was almost universally used. In more recent years, crosslines have been made of drawn platinum wire or wire of other metals. They have been etched on glass, photographed on glass, and also deposited on glass by a vaporization process using an electric arc. Each in turn represents an improved technique.

In 1763 the dividing engine was developed. This was a great step forward in the production of instruments. The graduations of the circles of instruments have been engraved, etched, or otherwise marked upon such various materials as brass, bronze, silver, ivory, aluminum, and glass.

The sextant was developed about 1740. This was, to a certain degree, a forerunner of our optical instruments of the present, since it employed mirrors to double the angles thereby giving somewhat greater accuracy. As is well known, the sextant is a portable, hand-held instrument easily capable of measuring angles within one minute of arc even though held on an unstable base such as the deck of a ship, under conditions where a transit would be useless. The sextant is an excellent example of the development of surveying instruments for a specialized purpose. As shown later, it sets a precedent to guide surveyors and instrumentmakers in boldly setting out to develop special instruments such as jig collimators, optical squares, optical collimators, and even

newer instruments for lowering costs in various fields.

Use of the planetable principle, which had developed almost concurrently with the earliest angle measuring instruments, was relegated to a minor role by the development of the telescope and the dividing engine so that it was about 1815 before the planetable and alidade again were used. However, it was the beginning of the current century before the advantages of the planetable for certain types of surveys or measurements were generally recognized.

The basic developments for measuring angles during the last four centuries have been the horizontal and vertical circles on their respective axes, the telescope and line of collimation, the dividing engine, the dry compass, sextant, and planetable. Of course, the instrumentmakers, with each new development, and continually, have been improving techniques. The item of crosslines has been mentioned. Also spindles or centers, clamps and tangent screws, structural strength, materials of construction, types of tripod, surface finish, and even aesthetics have been improved. Probably the greatest improvement recently has been in the optics of the telescopes and the radical variation of obtaining readings optically. At present, instrumentmakers have produced a wide range of precision instruments of the highest type, designed for the longest life and greatest service, for the most common operations where surveying instruments are used.

But new basic principles are continually being discovered. Among others, the developments in electronics made during World War II immediately come to mind. It is now time to reassess our positions to determine whether or not improvements can be made to incorporate these newly developed principles. After seeing the precision achieved using Shoran for measuring long lines on the earth's surface, we begin to appreciate that there are perhaps other possibilities.

Since dreams do not cost anything, let us take a moment to imagine what might be done. Let us consider topographic mapping at a large scale with a small contour interval for a project which is smaller than can economically be mapped by photogrammetric methods. Knowing that the electronic position indicator, commonly abbreviated EPI, is being used successfully for locating photogrammetric flight lines, we might establish a similar control of two or more points for the area to be mapped. This would supply a radar-controlled device at each end of a base line from which, in effect, angles would be measured to a third point thereby locating this unknown position. The unknown point might be a portable radio transmitter. As the radio is moved over the territory to be mapped, proper electronic controls measure the directions of the rays from the ends of the base line, reduce these to horizontal and vertical distances, and plot a topographic map on an instrument similar to a coordinatograph. Of course, whether such a fantastic device would be feasible or practical is something which would have to be determined by research. Government agencies and a very few private companies are conducting some of this basic research which will be of value to all. An intensive research program is essential for improved techniques and lower costs.

Now, having briefly examined the development of one of the basic surveying operations, namely measuring angles, let us return to the statement made earlier that surveying is a broad and basic subject. Engineers generally at least pay lip service to this statement. But, if surveying is so basic, why have those responsible for the curriculum in civil engineering in universities in the United States reduced the course content to one half or one third of what it was thirty years ago? Or why has surveying been entirely eliminated for so many chemical, mechanical, electrical, and other engineering students? The answer probably lies in the facts, first, that there were very few basic changes in surveying instruments for thirty years; second, that the youngest and least experienced teachers were all too frequently assigned to teach surveying; and third, that the basic aspects of making measurements

were overlooked. As a result, the so-called traditional civil engineering approach to surveying gave rise to the belief that the surveyor and his instruments could be used only for land surveying and making construction surveys except for a very few mysterious fellows who dealt with geodetic surveying. In looking for broader principles, we find the surveyor using many new instruments and techniques such as optical transits and collimators, electric and electronic computors, precision altimeters, all types of photogrammetric surveying equipment, electronic network analyzers for balancing errors, the approximations of statistical methods as well as the more conventional theory of least squares, electronic devices such as Sonar, Shoran, Loran, and the radar altimeter, to say nothing of the new equipment and techniques for mapping. If the surveying profession as a whole is not alert to these developments, it will suddenly discover its field of operations scattered and gone. For instance, aeronautical engineers or naval architects will be the men who will design, develop, and use jig transits and jig collimators, electrical engineers will do the geodetic control, engineering physicists will be the photogrammetric engineers, to name a few. The article in *Fortune* magazine for October 1951 entitled "Tooling Up By Telescope" is an excellent presentation of how basic surveying principles combined with surveying instruments can go into the manufacturing plant and do the same sort of job indoors that for years has been done by surveyors outside on other construction projects. Most engineering students now are being given training in the fields which contribute to the broad education required for the development and use of surveying instruments. These fields include optics, mechanics, statistics, electronics, astronomy, and mathematics among others.

Finally, the interrelation of the surveying profession, the instrumentmaker, and the engineering teachers must be stressed if we are to develop new equipment and methods for lower costs. All segments of the profession must conduct research. Probably during the last twenty years the engineering teachers have been least productive in this field. The instrumentmakers continually must be striving to produce better instruments. The practitioner in the field and office should continually be thinking of new methods to increase the productivity of his work and consequently he must conceive of improvements and demand better instruments from the manufacturers. The teachers must keep abreast of new developments, and must train and encourage students in the basic engineering sciences. In this way costs will be lowered and our profession will be developing as it should to prove that surveying is not dead.

Discussion

By D. H. HARKNESS

ENGINEER, W. & L. E. GURLEY, TROY, N. Y.

I WOULD LIKE to speak first as Secretary of Committee VIII on Surveying and Mapping of the Civil Engineering Division of the American Society for Engineering Education. Last August at the University of Illinois Summer Surveying Camp near Blackduck, Minn., Committee VIII and the University of Illinois cosponsored the Third National Surveying Teachers Conference. The various committees of this conference adopted certain resolutions which covered many of the points relative to surveying education raised in Professor McNair's paper. Feeling that these resolutions should most properly be brought to the attention of the heads of the colleges and universities, about 200 copies of the resolutions were recently mailed to these administrators. It was hoped that the objectives set forth would make the administrators cognizant of the importance of surveying and mapping in their educational scheme.

Now I would like to speak as a member of the Congress. A surveying instructor is in a peculiar position. Many times he knows the deficiencies of his course content, equipment, and time allotted for surveying instruction, but is unable to apply pressure for these adequate facilities because of his position.

It is my belief that this group should back up these instructors in their expressed needs for better facilities for teaching surveying. It was my thought that, as practicing engineers and surveyors, each individual could promote these objectives in his own Alma Mater. Pressure from without is quite often effective and we hope you will help us stem the tide that is threatening surveying in our universities.

New U. S. Atlas List Published

THE Library of Congress has published a second volume of its *United States Atlases*. It lists some 3,500 National, State, county, city, and regional atlases and plat books in the Library's collections and in those of 184 other libraries throughout the United States, and supplements the volume published in 1950, in which some 3,600 atlases in the Library's collections were listed.

This second volume includes the atlases and plat books received by the Library since 1949 as well as those in the collections of the 184 cooperating libraries. Of the 7,064 atlases listed in the two volumes, all but 2,173 are in the Library of Congress.

Atlases relating to the United States as a whole are listed chronologically and those for States and subdivisions of them are listed alphabetically under the names of the respective States. There is an author index. Fire insurance atlases published by the Sanborn Map Company have been excluded from this list, because the Library's collection of them is large enough to warrant a separate publication.

United States Atlases was compiled by Mrs. Clara Egli LeGear of the Library's Map Division. Copies of the new volume may be purchased from the Card Division, Library of Congress, Washington 25, D. C., for $2.50 each. Copies of Volume I are still available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for $2.25.

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Maps in Nova Scotia

By J. P. MESSERVEY

DEPUTY MINISTER OF MINES, PROVINCE OF NOVA SCOTIA

THE MAKING of maps and plans upon which to locate the boundaries of areas in which mineral rights have been licensed or leased in the Province of Nova Scotia has been a function of the Department of Mines since its inception. Many

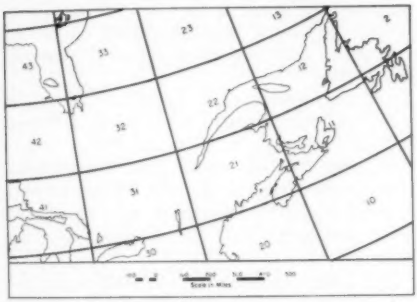

FIGURE 1.—Index map of Canada, No. 870A.

or leases for mineral rights could be granted by the Crown was always present.

By mutual agreement, the governments of Canada and the United States several years ago resolved upon a standard system of identifying topographical and geological maps. Since that time, all topographical maps issued by the Surveys and Mapping Branch of the Department of Mines and Technical Surveys of Canada, at Ottawa, as well as geological maps issued by the Geological Survey of the same Department, have been based on this system (*see* fig. 1).

Each standard map sheet of the National Topographic Series, published at a scale of 1 mile equals 1 inch, represents an area bounded by 30 minutes of longitude and 15 minutes of latitude (*see* fig. 2).

Maps at smaller scales are multiples of

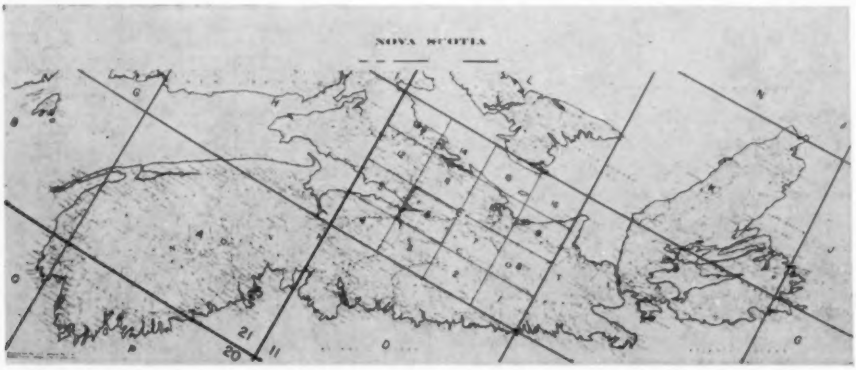

FIGURE 2.—Index map showing National Topographic Series as it applies in Nova Scotia.

systems and methods were adopted and tried from time to time but the need for a positive, simple, systematic means of delineating the tracts or areas in which licenses

the standard sheets; for example, a map published at the scale of 2 miles equals 1 inch contains 4 of the standard sheets, and a map published at the scale of 4 miles equals 1 inch includes 16 of the standard 1-mile sheets.

The part of the National Topographic Series which includes the Province of Nova

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Scotia is shown in figures 1 and 2. It covers parts of four of the main divisions, namely, numbers 10, 11, 20, and 21.

In the year 1940, the Department of Mines of Nova Scotia adopted this system for all its maps and plans pertaining to mineral rights and mines, and all prospecting licenses and leases for minerals in the Province of Nova Scotia have been issued on this system since that date.

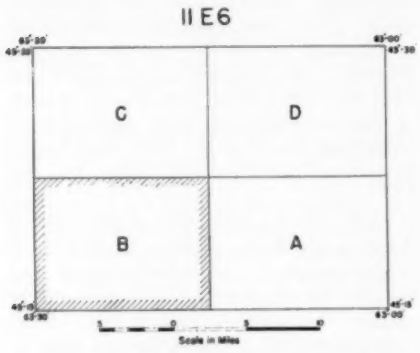

FIGURE 3.—Outline of National Topographic sheet No. 11 E 6, issued at scale of 1 inch equals 1 mile.

MINES ACT

Boundaries of mining lands.—Section 20 of the "Mines Act" for Nova Scotia, dealing with the boundaries of mining lands, is as follows:—

(1) The National Topographic Series Map sheets on scale of one mile to one inch established by the Department of Mines and Technical Surveys (Canada), and representing areas of ground bounded by each 30 minutes of longitude and each 15 minutes of latitude shall be used at a basis for the purpose of determining the boundaries of mineral land, licenses and leases within the Province.

(2) The area of ground represented by each National Topographic map sheet shall be considered as subdivided into four quarters, as shown in figure 3, by median lines corresponding to the median longitude and latitude lines of the map sheet, and the four quarters thus produced shall be lettered, for the southeast quarter "A," southwest quarter "B," northwest quarter "C," northeast quarter "D."

(3) Each quarter sheet determined by subsection (2) above shall be considered as subdivided into 108 tracts as shown in figure 4, twelve divisions on latitude and nine divisions on longitude. The 108 tracts so determined shall be numbered consecutively from 1, starting at the southeast corner of each quarter sheet, and numbering westward to 12, then, above, consecutively from 13 eastward to 24, and in such order continuously until the 108 tracts are numbered.

(4) Each such parcel of land shall be termed a *mining tract*, and for the purpose of this Act shall be considered to contain a square mile. (Note: A mining tract, therefore, covers an area of 75 seconds of longitude and 50 seconds of latitude.)

(5) Each mining tract may be considered as subdivided further into sixteen parcels as shown in figure 5, four on latitudes and four on longitudes, lettered consecutively from the southeast corner of each tract *A, B, C, D*, westerly; above, *E, F, G, H*, easterly; and so on, until the sixteen have been given a letter, omitting only the letter *I*.

(6) Each such parcel of land shall be termed a *mining claim*, and for the purpose of this Act shall be considered to contain forty acres.

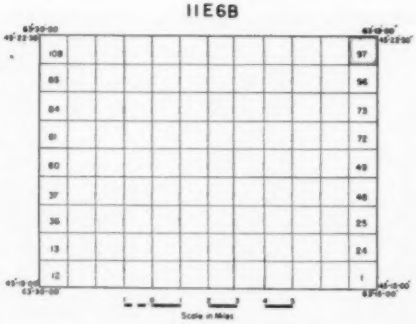

FIGURE 4.—Outline of quarter sheet No. 11 E 6 B, issued at a scale 1 inch equals ½ mile.

(7) Maps of each quarter sheet (fig. 4) on a scale of two inches to one mile shall be prepared and kept in the files of the Department of Mines of Nova Scotia. These maps shall be the official maps, representing all mineral land licenses and leases within the Province. For each such map there shall be recorded the calculated length and azimuth (astronomic) of each boundary of each of the 108 tracts into which the quarter sheet is subdivided. East

and west boundaries of each tract shall be true meridians of longitude. North and south boundaries shall be straight lines, parallel to the chord of the parallel of latitude that represents the south boundary of each quarter map sheet. The angle of intersection of each chord on either side of the median meridian of longitude for each quarter map sheet shall be 90°.

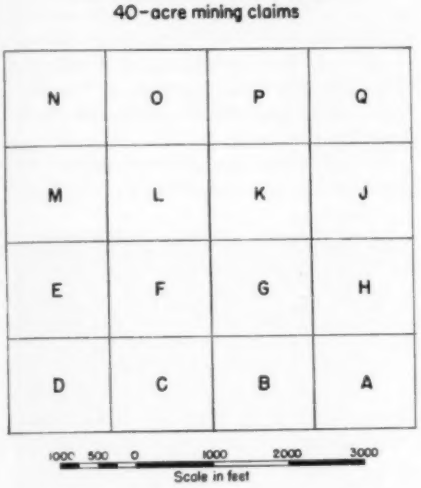

FIGURE 5.—Outline of one mining tract showing how it is divided into 16 40-acre claims.

(8) Any lease issued prior to the first day of July, 1940, will continue in force until its expiry date by the method under which it was issued (this was by description with metes and bounds), or it may be surrendered at any time prior to its expiry date for redelineation under the provisions of this Section, and the Minister may issue a new lease or leases for the unexpired term of the surrendered lease and for any renewals thereof to which the holder of the surrendered lease was entitled under this Act or any other act. (Note: Prospecting licenses are issued for a period of 1 year so that all licenses issued by the previous method of description become extinct within 1 year from the passing of the 1940 Mines Act.)

(9) All mines shall be laid off under the mining claims established by this Section. All boundaries shall extend downward vertically on all sides. Surface measurements shall be horizontal.

Surface rights.—No holder of mineral rights may enter upon any private lands for the purpose of prospecting or mining except with the consent of the owner. If the owner will not make a satisfactory agreement (which is seldom the case), the licensee or lessee may petition the Minister of Mines for a special hearing. After the conclusion of a hearing of evidence under oath from both parties, the Minister may (*a*) dismiss the petition; or (*b*) allow it in whole or in part; or (*c*) make such further order for the disposal of the case as appears to him to be just; and (*d*) fix and determine the amount of compensation to be paid the owner, or declare that the amount shall be determined by arbitration.

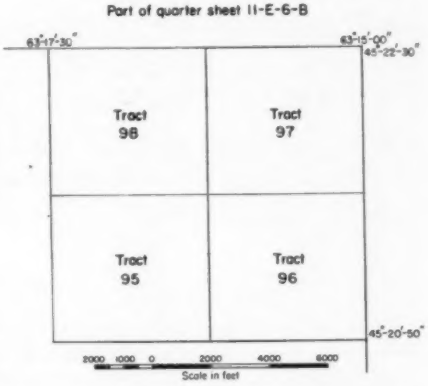

FIGURE 6.—Outline of manuscripts covering mineralized areas as plotted from aerial photos on a scale of 1 inch equals 400 feet.

OFFICE PLANS

The quarter sheets of the National Topographic Map series at a scale of ½ mile equals 1 inch, which are used for the issuance and indexing of licenses and leases for mineral rights in the Province, are made from the ½ mile to 1 inch plots of the standard topographical sheets of the Surveys and Mapping Branch of the Department of Mines and Technical Surveys, Ottawa, which have been constructed from aerial photographs taken at scales of ¼ mile and ½ mile to 1 inch.

Maps of the isolated mineralized areas in Nova Scotia are made by the Department of Mines at a scale of 400 feet to 1 inch from 9- by 9-inch aerial photographs (400 feet to 1 inch approximate scale) taken by the Province. These maps are plotted on manuscript sheets (30 by 34 inches) with four mining tracts per sheet (fig. 6) and form an integral part of the map system of the Province as described in the preceding sections.

MAP DISTRIBUTION

The Department of Mines makes extensive use of the topographical and geographical maps supplied by the Federal Government in their investigations and reports on minerals and also purchases a supply of maps for resale to prospectors and mine operators and to the general public.

TOWN PLANS

About 4 years ago the Department of Municipal Affairs of Nova Scotia required that the incorporated cities and towns of the Province have accurate plans made of the area within their boundaries at a scale of 200 feet to 1 inch from aerial photographs. As the Department of Mines was fully equipped to do mapping at the large scales, Municipal Affairs requested us to undertake this work.

The horizontal and vertical control required for the accurate plotting of the plans

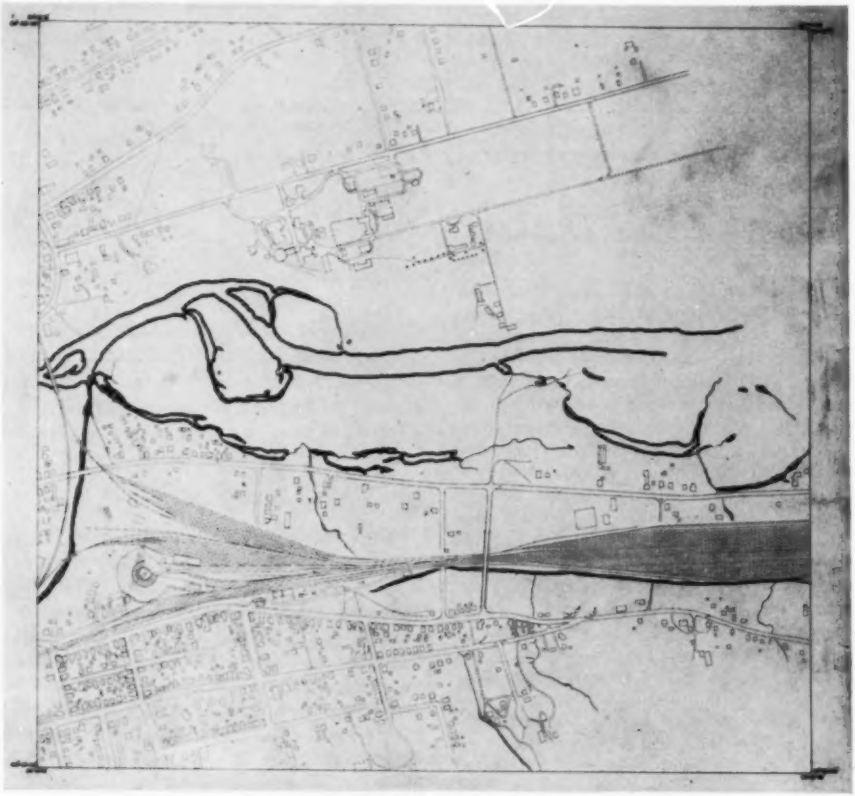

FIGURE 7.—Photograph of actual manuscript of tract No. 97 11 E 6 B plotted from aerial photographs at scale of 1 inch equals 200 feet.

from aerial photographs is performed by a survey party during the summer months, the cost of which is borne by the town.

The work performed in the office of the Department of Mines, which includes the compilation of the survey notes down to the completed manuscript, is contributed by the Department. The finished manuscripts, therefore, become the property of the Government, but linen tracings or reflex film tracings made from the manuscripts are supplied to the towns at cost.

The maps of the towns are plotted on manuscript sheets (30 by 34 inches) with one mining tract (75 seconds of longitude by 50 seconds of latitude) per sheet (fig. 7) and form an integral part of the map system of the Province, as previously described.

If the photographs of a town prove satisfactory for the reproduction of a map or plan, one-half of the cost of the aerial photography is refunded by the Department of Municipal Affairs to the town in question. Both the negatives and the set of prints supplied by the contractor become the property of the Government and are filed in the Department of Mines.

For this large-scale mapping the Department of Mines requires that the area or areas be photographed during the spring months in the period between the disappearance of snow and ice and before the deciduous trees start to leaf out. In case of an emergency, the photography may be taken in the fall months after the deciduous trees have lost their foliage and before snow and ice appear. However, in these latitudes the latter time of the year is not desirable because the shadows produced by the lower elevation of the sun are very long and tend to obliterate detail.

SPECIFICATIONS FOR LARGE-SCALE AERIAL PHOTOGRAPHS

Overlap in Line of Flight.—Nominal overlap shall be 60% fore-and-aft (or forward) in the line of flight. Fore-and-aft overlap of 54% or less shall be considered as a gap. Fore-and-aft overlap in excess of 70% may be rejected.

Overlap Between Flights.—Lateral (or side) overlap between strips shall be 25%. Lateral overlap less than 20% shall be considered as a gap. Lateral overlap in excess of 30% may be rejected.

Overlap Project Boundaries.—End overlaps beyond the project boundaries shall be a minimum of 25%.

Gaps.—Gaps, either physical or as defined above, shall be filled by re-flying the strip or strips in question.

Tilt.—Although tilt should be kept at a minimum, no tilt over 3% will be accepted, and the overlap as defined above must be maintained.

Crab.—Crab should be absent, but the same principle regarding overlap as stated above must be maintained within the specified limits.

Direction.—Lines of flight in Nova Scotia are to be flown approximately east and west wherever the outline of a project makes it possible.

Period of Year.—Photographs are to be taken preferably in the spring before the deciduous trees begin to leaf out; otherwise, in the fall, after the deciduous trees have lost their foliage.

Time and Light Conditions.—Photographs are to be taken during the middle portion of day and under light conditions that will give photographs whose details will not be obscured by dense shadows.

Photographs (for 200-foot photography).—Aerial photographs must be taken vertically, on 9- by 9-inch negatives, with a lens whose focal length is 12 inches or longer, and at a horizontal scale of 1 inch equals 200 feet (approximately). Negatives will become the property of the Department of Mines, Province of Nova Scotia. Contractor shall furnish two contact prints on double-weight paper with semigloss finish, and two reduced prints on single-weight paper with glossy finish at a scale of 1 inch equals 400 feet. (Note: For 9- by 9-inch photographs taken at a scale of 400 feet to 1 inch, the same general specifications apply, except that the two contact prints on double-weight paper shall be at a scale of 1 inch equals 400 feet, and the two reduced

prints on single-weight paper with glossy finish shall be at a scale of 1 inch equals 800 feet. The reduced prints at scales of 1 inch equals 400 feet and 1 inch equals 800 feet mentioned above are used by the Department to make mosaics of the areas photographed.)

PLOTTING SHEETS

The base topographical maps of the Province are plotted on a 100 percent linen, water-resistant drawing paper of about 0.011 inch thickness (K & E No. 24 HP GRIFFIN drawing paper) mounted with plastic cement upon sheets of aluminum 0.022 inch thick. In order to conserve aluminum and also reduce filing space, the drawing paper is mounted on both sides of each aluminum sheet.

The Department of Mines has a 50- by 62-inch vacuum printing frame, along with four arc lamps, and provides reflex tracings from the manuscripts, either on Kodagraph autopositive film or Kodagraph autopositive translucent paper. The photographic branch of the Department is also equipped with a 24- by 24-inch precision dark-room camera having both standard- and long-focal-length lenses for the production of both negative and positive films at reduced or enlarged scales.

MAPS USED BY OTHER PROVINCIAL GOVERNMENT DEPARTMENTS

Department of Lands and Forests.—The Department of Lands and Forests makes extensive use of the aerial photographs taken by the Federal Government at scales of $\frac{1}{4}$ and $\frac{1}{2}$ mile to the inch for estimation of timberlands. The Department also has a complete set of map sheets of the Province at a scale of $\frac{1}{2}$ mile to 1 inch on which are plotted all the original grants of lands or parcels of land granted by the Crown, as well as the many areas in the Province which are still Crown land. Topographical maps at a scale of $\frac{1}{2}$ mile to 1 inch as supplied by the Department of Mines and Technical Surveys, Ottawa, are used for the plotting of their surveys and the lines of the grants.

All their grant map sheets are rectangular divisions of the Province, with all references made to magnetic north, but they have recently started a new series of sheets based on the National Topographic Series map sheets, thus following the system adopted by the Department of Mines for their mineral licenses and leases.

Bureau of Information.—The Bureau of Information for the Province of Nova Scotia has reduced the map of the Province to a scale of 10 miles to 1 inch, on which is shown the information pertaining to the highways of the Province. The Bureau of Information distributes about 150,000 copies of this map to the general public each year.

The Nova Scotia Power Commission.—The Nova Scotia Power Commission makes use of the aerial photographs of the Province for their preliminary investigation of a watershed and the location of power and dam sites in connection with a new power development. They make use of the topographical maps furnished by the Federal Government at a scale of $\frac{1}{2}$ mile to 1 inch on which to locate the watersheds, power and dam sites, and all transmission lines throughout the Province. The plans of grants as plotted by the Department of Lands and Forests are also used by the Power Commission to aid in the determination of property rights and rights of way.

Department of Highways.—In the initial investigation for reconstruction of roads, the Department of Highways makes use of the topographical map sheets at a scale of 1 mile to 1 inch provided by the Federal Government, along with the $\frac{1}{4}$- and $\frac{1}{2}$-mile to the inch aerial photographs. This enables them to determine where their reconnaissance and preliminary surveys should be made. Thus many map sheets at scales of 1 mile and $\frac{1}{2}$ mile to the inch are used each year by the Department. Finally, the selected route or alternative routes are photographed from the air at a scale of 1 inch equals 500 feet for more exact studies, coordination of ground surveys, and for the preparation of mosaics.

Military Topographic Maps of the Future

By CYRUS G. FINLEY, JR.
OPERATIONS AND PLANNING STAFF, ARMY MAP SERVICE

BEFORE beginning our prediction on the design of the military map of the future, let me first define what I consider a military map. It is simply a standard topographic map with a few modifications consisting of the addition of a military grid and the elimination of items of a purely civil nature, such as landlines. Sometimes a road classification overprint is added, but basically the map is still the standard topo sheet.

The precision with which the average topographic map is prepared will suffice for the present and very likely for the future military map. The contents of the topographic map with some minor exceptions also will probably be adequate in the future as a base from which military maps can be made. But the manner of presentation of information will see some interesting innovations.

We as map makers have come to accept certain conventions in symbolization and color used in depicting categories of map features. We have accepted red and black as standard colors for presenting cultural features. Brown is used for relief features. Blue is used for features associated with water and green for vegetation features. Considering the use to which the maps are put, especially medium- and large-scale military maps, the time has come to review some of these conventional practices and see if they can be improved.

In order to better project our thinking into the future, let us review the trends in map design, past and present. Originally, map portrayal was purely a pictorial presentation. Gradually this treatment gave way to symbolization as requirements for additional detail and precision necessitated a means for depicting features with a minimum of exaggeration and displacement. This trend in refinement has apparently reached its ultimate expression in the large-scale maps of Central Europe. Here we find a map detail expressed in a myriad of symbols. Intelligent interpretation requires familiarity with all these different symbols. Insofar as map content is concerned, these maps are more than adequate from a military standpoint. However, the degree of training required to understand them complicates the military use of the map. We have simplified our maps by certain modifications. For example, a built-up area tint is used to replace the many complex building symbols used to show this area, with selected landmark building symbols being retained and emphasized. Another simplification has been the use of color for greater latitude in road classification to replace intricate symbols used to represent political classifications, road widths, gradients, and similar aspects.

The three major elements of design toward which the greatest efforts are presently being directed are: methods for improving graphic portrayal of relief, means for producing three-dimensional relief maps, and development of colors which will be visible under particular lighting conditions.

Emphasis is being placed on means for improving the representation of relief since the visualization of terrain from contours offers the greatest difficulty in topographic map reading. Toward this end a three-dimensional effect is achieved through the use of hill shading to supplement the contours. Although the concept of shaded relief is not a new one, methods for producing this effect without tedious and time-consuming hand techniques employed in the past are receiving a great deal of attention. At present, the air brush method for preparing drawings for reproducing shaded re-

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lief has received wide acceptance although this method needs refinement, particularly from the reproduction standpoint. Another method being investigated is the photography of terrain models using a special camera. This special photographic equipment, developed at the Army Map Service, allows for some entirely new concepts in graphic presentation of terrain. This equipment allows us to take an orthographic view of the terrain model, retaining uniform scale and true azimuth throughout the entire image area. With proper lighting effects, this process can be used to produce photographs for lithographic reproduction of shaded relief on conventional maps. This same equipment can be used to provide oblique views which will result in an image on which lines of sight are parallel to each other. This produces a "graphic" in which relief displacement is uniform and in the same direction, allowing for accurate measurement of relief. In addition to being capable of producing orthographic views, this equipment can be manipulated so that lines of sight may be caused to converge on any objective within the area being photographed. For the first time, the map designer has at his disposal equipment with which lines of sight are completely at his command. These lines of sight may be made to converge, remain parallel, or diverge. Furthermore, any of these oblique views may be made in stereo pairs. The graphics produced with this equipment seem to have many military applications.

Another approach toward satisfying this desire for a relatively simple relief interpretive product is the plastic relief map. Since the end of World War II rapid strides have been made in mass production techniques for producing plastic relief maps. These maps have received such favorable comment that they might even now be considered a military necessity. Although currently widely used for instruction, briefing, and planning purposes, their use in the field is limited because of certain undesirable characteristics. Principal among these are their inability to be folded and carried like a paper map, lack of devices for making quantitative measurements on relief surfaces, and lack of facilities for field production. These deficiencies can probably be overcome by the application of new materials and techniques now under investigation.

As stated previously, we are bound by conventions well established in the map users' minds as to the use of colors for portrayal of categories of features on topographic maps. The selection of these colors is an appropriate one when a map is used under normal lighting. Military operations often preclude the use of normal lights. Under certain conditions, the various colors on a map which are clearly distinguishable under normal lighting are reduced to a monochrome or become invisible. For example, the red light used in forward battle areas to minimize detection by the enemy causes the symbols shown in red on the map to become invisible. To overcome this deficiency, investigation is being conducted toward the addition of certain pigments to the red inks or toward complete substitution of other colors in lieu of red. Colors on military maps must be so selected that proper balance and color value are retained under the conditions in which the map is used as well as under normal lights.

In addition to these major elements of design, there are other factors which are also worthy of consideration. The presentation of vegetation under present specifications leaves much to be desired, inasmuch as, in many cases, definitive limits for types of vegetation are difficult to compile because of the very nature of vegetation itself. Two solutions to this problem present themselves. First, the method currently used on large-scale maps in Central Europe whereby density is shown by frequency of symbol and scattered trees and clumps of trees can be shown by individual symbols. This method is tedious and time-consuming and necessitates very detailed ground reconnaissance which is not always possible in military mapping. The second method under consideration is the photography of a photo mosaic of the map sheet area so taken as to eliminate all but vegetation fea-

tures and the subsequent printing of this special vegetation negative on the conventional map. This procedure is very likely to be limited by the photography available and the nature of the vegetation. Similarly, in desert areas where characteristic dune formations are prevalent, this method may be adaptable for obtaining a more pictorial portrayal of the ground conditions. Both of these techniques are an attempt to substitute a more realistic view of the ground for the artificial map symbolization. There is room for further exploitation of photomaps as the companion to the conventional line map as a means of introducing more realism into military cartography. In this connection it may prove feasible to print photomaps in color.

In summary, it can be stated that the topographic map as presently produced will remain the basic source for preparation of the military map. It also appears certain that military maps in the future will become more specialized and will be designed to meet the particular needs of the individual service users. The methods and techniques that will be used to achieve the desired aims will make use of more pictorial representation, photographic processes, and a more effective color usage. The military map of the future will be the topographic map in a new uniform.

DISCUSSION

MR. WHITTAKER: I should like to ask Mr. Finley why it is that there seems to be so much difficulty in interpreting these contour lines as being representative of the topographic surface. It seems to me that it would be difficult to find a more graphic system. I was wondering if Mr. Finley regards the ultimate solution to this problem as a combination of the contour lines with some other form representing this surface. For instance, are shaded relief drawings combined with the contour lines regarded by the map users that you have contacted as being a more ideal representation of the surface? Is there any possibility that they will bring back the old hachure lines? Is there any anticipated use of graded tints for anything other than aerial charts?

MR. FINLEY: I did not intend to get the impression across that I was advocating dropping of the contour lines from maps, especially from an engineering standpoint. The contour lines that express the relief form the base for the whole topographic map. I was just advocating the use of some means to supplement these contours, such as shaded relief printed in conjunction with the contours. Even the plastic relief maps that we produce still have the contours on them as a means of making more accurate measurements. Does that answer the question?

MR. WHITTAKER: Yes, that straightens me out on the value of contours, but as far as combining those contours with other means, is that going to be a rather standard procedure from now on? It seems relatively new to me.

MR. FINLEY: Well, everything we are doing at the Army Map Service is relatively new. We are a relatively new agency. We have more or less adopted shaded relief as a standard for our 1:250,000 scale map series. It has been very popular. The shaded relief is in addition to the contours.

We have been asked recently to produce shaded relief drawings for 1:100,000 scale maps. We have not done it yet, but there is quite a lot of favorable comment on the fact that there should be shaded relief on 1:100,000 scale maps as a supplement to the contours.

MR. MAY: I would like to direct a question to Mr. Finley. I noticed that he referred several times to plastic relief maps. I would like to ask what the trend is now in such relief maps, and also what has become of the small-scale rubber models we used to see?

MR. FINLEY: The small-scale rubber models are still produced in limited quantity. The big disadvantage to those is their excessive cost inasmuch as each individual copy has to be hand painted as it is produced. The advantage of the plastic relief maps is, of course, that they are photographic reproductions of line maps; they are molded over a model, and they require no hand painting, or very little hand work of any kind except for the construction of the master model itself.

LIEUTENANT STANDARD: I would like to comment for a moment on this plastic relief map. I have fallen heir to the job of teaching the subject of map reading to new men coming into the Army. Many of them have never used a map before, or if they have used a map, it is probably only a road map. The concept

of contour lines is almost unknown to them since they probably have never seen them on a map. The job of teaching these new men to read contours is, therefore, quite difficult. The plastic relief map, since it shows the relationship between relief and contours, is a valuable aid for me in teaching the contour concept.

I would like to comment also as a user of maps. Speaking only for the Army users, I should like to ask that maps be kept as simple as possible. They have to be understood by the men in the field, and we do not want too much on the map to confuse them.

MR. LYDDAN: The showing of relief shading on maps which also carry the woodland overprint seems to me to create a conflict that is difficult to reconcile. I wonder if you would care to comment on that? Is the vegetation information valuable enough to justify showing both of them, or do you get complaints from users who find them to be in conflict?

MR. FINLEY: I agree that the showing of the green over the shaded relief areas certainly detracts from the effect of the shading. The question of whether vegetation information is valuable on a military map or not is one that I cannot answer. There have been many comments, both pro and con, on that subject. I think that the Europeans have a solution to that. They show their vegetation by a symbol on the black plate which does not detract from the shaded relief. So, it is possible to show vegetation features and shading as well, but, as I have said before, the presentation of vegetation information by these symbols on the black is very tedious and time-consuming, and we have not found the time to do that.

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Use of Control for Cadastral Surveys

By NEWELL B. SNOW
REGISTERED LAND SURVEYOR, MASSACHUSETTS

AS A LAND SURVEYOR with 27 years of practice, I have been able in recent years to notice a general improvement in land surveying techniques. The establishment of State Coordinate Systems, coupled with an increased use of aerial photography, has enabled us to turn out more and better work. In many instances this has resulted in substantial savings for our clients.

All land surveyors are conscious of past difficulties in the retracement of old surveys, due to the disappearance of corner markings, poor deed descriptions, and the absence of ties to any reference monuments. Also, most of us understand that the necessity for adequate control for a survey of any large area increases somewhat in proportion to its size. We know that the extension of a State Coordinate System into an area not now so covered provides assistance for future land surveys in that area.

My own practice has been in that part of southeastern Massachusetts including Barnstable County, or Cape Cod, and adjacent towns in Plymouth County, an area of about 450 square miles. There are 14 land surveying firms in the area, and nearly all of them now use the Massachusetts Coordinate System whenever it is available. The system was legally established by our legisture under Chapter 47 of the Acts of 1941, providing one zone for the entire State except for our island counties of Dukes County and Nantucket.

The control stations established throughout the area by the Massachusetts Geodetic Survey (MGS), under the able direction of E. C. Houdlette, make our coordinate system available to about 30 percent of our properties at the present time, and this coverage is being increased rapidly by State highway and municipal surveys based on the system. Our section of the State was more fortunate than the rest in that before the initial project creating the Massachusetts Geodetic Survey had ended, quadrangle books were published which gave the coordinates and descriptions of all stations in the greater part of the area.

I have found that the U. S. Coast & Geodetic Survey position lists giving the Massachusetts plane coordinates of all its points in the State are indispensable and a source of constant reference. The only suggestion which I could make is that the accompanying descriptions of stations be revised periodically on an alphabetical basis for each section as this would save time in finding the description for any station.

COST SAVINGS

It is possible to form a fair estimate in some cases of the substantial saving which can result through the use of the State Coordinate System over what would have been the cost for adequate control prior to the establishment of the system. The following two examples indicate this quite clearly.

In the preparation of assessors' maps for two towns some 25 years ago, I found that about 65 percent of the field work time was being spent upon some form of control, either in extending a triangulation network from the few existing USC&GS stations, or in executing traverses along the street systems. This left only 35 percent of the field work time for the location of property lines, the primary purpose of the work. In a town in which I am currently engaged in the preparation of assessors' maps, and in which there is a fairly adequate number of MGS control stations, only about 40 percent of the field work time has been spent upon control. This includes closed traverses along the street system and along the shorefront with suitable ties to the control stations. This 40 percent would have been

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somewhat reduced had the town possessed accurate layouts of some of its streets. The location of large marshy areas, creeks, and some of the property lines are now being obtained from aerial photographs, preferably from flights made prior to the running of traverses in an area, so that a sufficient number of points appearing on the photographs may be located on the ground to insure accuracy in plotting, and so that the field party will have a picture to guide in the actual location of traverse lines.

I have almost completed surveys for one client who had acquired 215 parcels of land in two of our Cape towns, containing in all an area of about 3 square miles. Some of the parcels were contiguous but many were widely separated from the principal area and altogether were spread over some 12 square miles. Fortunately, there were 20 control stations scattered through the area so that it was possible to maintain excellent control without expending much time for purely control survey work. A conservative estimate of the saving in cost to this client would be about $1500.

An item of intangible value, but of very considerable interest to us as land surveyors, is the peace of mind which results after running an extensive traverse between two control points for the purpose of tying in a survey and finding that the traverse closes within proper limits. The coordinate values can then be extended safely without the possibility that some error in the field work or in the computing will result in an entirely incorrect set of values.

LOSS OF MONUMENTS

In Massachusetts our Land Registration Act provides for the establishment of both the title to the land and the property lines, the latter to be as shown on a plan prepared by the Land Court Engineering Department. This department depends on a plan filed with the original petition for registration and prepared in accordance with Land Court instructions. Connections with any control points within 300 feet of locus is required. Poor ties have occasionally resulted in the calculation of an incorrect set of coordinate values. In my opinion, the only permissible substitute for a traverse closure from one control point to another, in the event that distance or physical obstruction makes this procedure impractical, is a pair of observational checks to distant stations made from the farthest possible point on the traverse from the original control point. Any large error in coordinates will be revealed by a comparison of the measured azimuths to the distant stations with the inverses as computed.

Certain work by the USC&GS and by the MGS in our area would assist materially in the use and extension of the coordinate system. Since completion of the field work done by the MGS in the late 1930's, some 11 elevated water tanks have been erected in six of our towns, and two of our fire observation towers have been relocated. All of these are points which may be seen from many locations in the area and their coordinate values would be very useful.

In running traverses between stations the MGS established a number of semi-permanent traverse points which are still undisturbed. The positions of these points were not published and can be obtained only by searching through MGS records in Boston. A program of replacing the points with permanent control bounds or, at least, publishing the coordinate values of such points, would effectively serve to make control available in areas where the stations are far apart.

The loss of a considerable number of stations along the south shore of the Cape through erosion has left many gaps in the originally established system. Because of its high value, more land surveys are being made in this area than in any other section of the Cape, and yet it is now impossible to tie some of these surveys to the coordinate system because of the loss of these stations. Also, a number of our control stations are located in rather vulnerable positions along our highways. They are exposed to attack from the two principal enemies of all monuments, the bulldozer and the road grader. In this connection, I can remember sadly reporting to Mr. Houdlette's office a few

years ago that one of his control stations no longer existed. A week before, while driving past a station located near the side of the street, I saw a ditch digger engaged in a water main extension. I showed the station to the foreman and to the engineer in charge and they agreed to tunnel past the point. This was done successfully. Passing by the next day I saw that the station was now inclined at a 45-degree angle and nearby cleat-marks showed that the bulldozer engaged in back-filling the ditch had accomplished its mission. Seriously, I believe that a program should be instituted to preserve stations in exposed locations, both along our highways and along our shores where erosion threatens, by the establishment of reference points in secure locations.

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New Book on Color

A WELL-KNOWN ink and drafting supply company[1] this year released a new book entitled "Color Digest." This lavishly illustrated book, written by Bert Cholet, presents one of the most complete and scientific treatises in layman's language on the subject of color.

Attached to the back cover is an envelope containing all the parts for assembling an authentic Ostwald solid in an ingenious arrangement devised by Mr. Cholet. This highly practical device demonstrates the 3-dimensional aspect of color in a graphic manner and shows the true association of hues with each other.

The book retails for $2.00 and may be obtained from the ink company.

[1] Higgins Ink Co., Inc., Brooklyn 15, N. Y.

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Direct Use of Oblique Air Photos for Small-Scale Maps

By ERWIN RAISZ
HARVARD UNIVERSITY

DURING the last decade, about a fourth of the earth's land has been systematically photographed by trimetrogon cameras from a height of about 20,000 feet. It takes only a few hours to photograph areas which require months to translate into maps, and the backlog is piling up so that it will take many years to catch up. Can anything be done to use our enormous stockpile of photographs to improve on small-scale maps directly, instead of waiting until the large-scale maps are finished and generalizing from those?

The answer depends on what the map is to be used for. In military terms, we might differentiate between "tactical" and "strategic" uses. For accurate detail in laying out roads, measuring land slopes, town planning, and so on, the detailed maps are indispensable, but when we want to learn about the whole of the land and the over-all patterns, when the nature of the land is more important than the accuracy of detail, the quantitative gives way to the qualitative and the answer lies in "landform" and land-type maps.

All men on wings must have felt that our present map conventions—at least on small-scale maps—are not satisfactory. The colors and patterns of the maps in hand have little relation to the rich carpet of the land below, albeit the line work—roads, railways, shores—is well presented. Something has to be done to close the gap between country and map.

BASIC APPROACHES TO MAP MAKING

The thoughts of this author on the subject were expressed in an article, "Landform, Landscape, Land-use, and Land-type Maps," (*Jour. of Geog.*, v. 45, pp. 85–90, March 1946; also in SURVEYING AND MAPPING, v. 6, pp. 220–223, 1946). It would be out of place to go deeply into these discussions here. It should be sufficient to say that the title represents the four basic approaches to making a map. The *landform* approach shows the nature of the relief, by contours on large-scale maps, with physiographic symbols on small-scale maps.[1] The *landscape* approach means to use the colors and patterns as they appear to the eye. A colored air-photo with symbols and lettering added would make a good large-scale map, and a naturalistic pattern-color design system could be used on small-scale maps. The *land-use* approach obviously emphasizes man's work. A *land-type* map is a combination of the first three.

The author had an opportunity to accomplish at least the first step when called upon to make landform maps of various parts of the world, such as Alaska, Canada, Arabia, the Near East, and North Africa, on scales of 1:2,500,000 to 1:5,500,000, for the Environmental Protection Section of the Quartermaster General's Office, (*see* fig. 1).

LANDFORM MAPS FROM OBLIQUE PHOTOS

A landform map shows much more than a contour map on the same scale, and can be made only if detailed topographic sheets and a good geologic map exist. In none of the areas was this true. It happened, however, that in Washington and Ottawa a good coverage of trimetrogon photographs was available, either in the form of rolls of negatives or as sets of positives.

The verticals of trimetrogon photography are of little use for this purpose. On a 1:4,000,000 scale map they come to only

[1] RAISZ, E.: The Physiographic Method of Representing Scenery on Maps, *Geog. Rev.*, v. 21, 1931, pp. 297–304; also *General Cartography*, 2nd ed., pp. 120–121, New York, 1948.

about 1/16th-inch square—too small to fill with any detail. The side pictures, however, often enable one to see 30 miles or more, and the appearance of the land is also more familiar than in verticals.

It is possible to use rolls of negatives but it is not convenient. Looking through the negatives at a light-table is hard on the eyes, especially as it is necessary to shift one's glance constantly from the negatives to the ill-lighted paper of the map. The hills and and mountains generally show up well on negatives but the unfamiliar patterns on plains and deserts are confusing.

As many of the photographs are classified, special permission is necessary for their use. Photos are available at AFSAG, Photo Records and Services Division, Library Branch, and some also at the Special Maps Branch of the U. S. Geological Survey. In Ottawa, the Airphoto Library of the Army has to be consulted.

STEPS IN MAKING LANDFORM MAPS

1. *Selection of flights.*—In all the abovementioned offices, flight-index maps are available. These are ozalid overlays upon the 1:1,000,000 aeronautical charts, showing the location of every third or fourth picture. With good visibility, it would be a waste of time to look at every roll if they are close together. Usually it is enough to select parallel flights about 30 miles apart with a few cross flights for checking. North-south flights are preferable to east-west flights as they do not show such great differ-

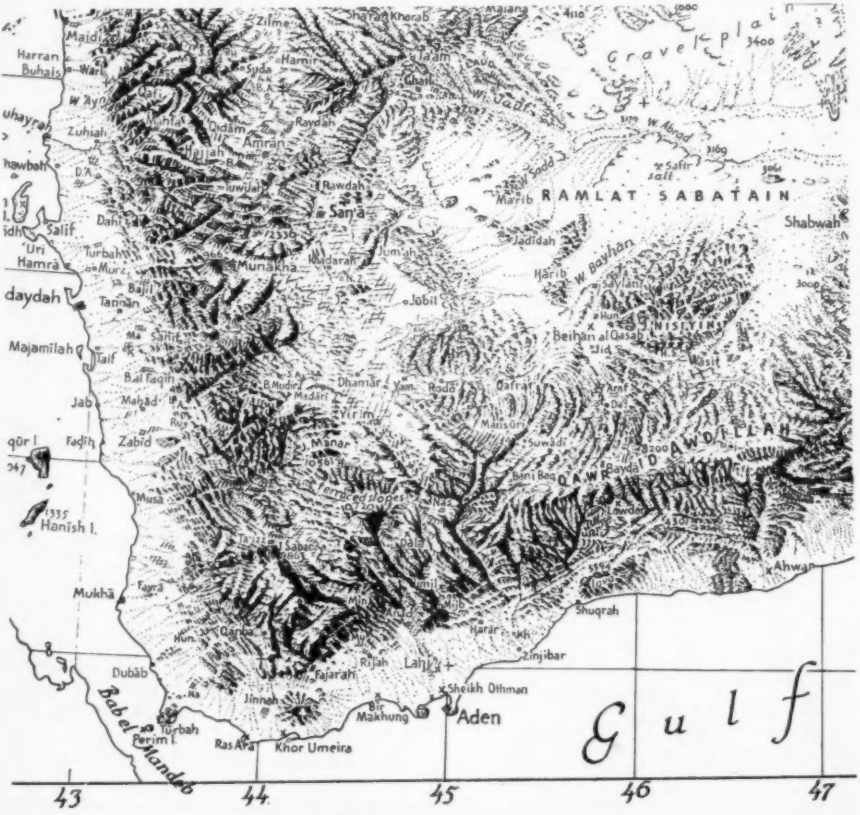

FIGURE 1.—Part of landform map of Arabia.

ences due to lighting, especially in higher latitudes. Flights with no "crab" are preferable.

2. *Transfer of index to aeronautical charts.*—While the selected runs of pictures are being delivered, the time is best utilized by placing a 1:1,000,000 scale aeronautical chart over the index map on the light table, and marking the flight line with every tenth picture numbered.

FIGURE 2.—Annotated aeronautical chart. Abbreviations: *H* = Hamada (deflated limestone or sandstone plateau), *S* = Sand, *FL* = Featureless area, *D* = Dentritic dissection, *Kn3* = Knob 300 feet high.

If there is "crab" it has to be indicated also.

3. *Annotation of the World Aeronautical Chart.*—This is by far the most important phase of the work. It is not necessary to look at every picture. Time is better used by looking more intently at every tenth picture in uniform areas or at every fifth picture in more complex regions. There is about 60 percent overlap in the verticals and increasingly more in the side pictures.

The annotation of the charts is done partly by drawing, partly by writing, (*see* fig. 2). The map is held perpendicularly to the flight line, the way the side pictures point. Ridges, sinkholes, knobs, lava, etc., can be drawn directly on the chart in somewhat symbolized fashion. There should also be a description which liberally uses abbreviations, as D^2 = dendritic 200-foot relief, $S/4$ = one-fourth of the region is sand-choked, H = hamada, Gnp = gneissic peneplain, M^5 = mature dissection 500-foot relief, FL = featureless plain, etc. Symbols and abbreviations are made up as they occur but are carefully noted on the side of *each* map. It is good to keep a geological map handy and scan particularly for the edges of the various formations. It takes about two hours to mark up one side of a 300-mile flight representing 6,000 square miles.

4. *Allocation of features.*—Although the roads and rivers on the aeronautical charts help to locate features, usually they are not sufficient and a great deal of allocation is necessary. Using for a base the index-map location of the pictures, distant features can easily be triangulated. Most trimetrogon pictures are taken from a height of 20,000 feet; the side pictures are taken with the camera pointed 30° downward from the horizontal. Thus the angles of nearby objects differ from their direction on the photographs, but features near the horizon are nearly in the same direction as the line drawn from the front center of the photo to them.

A rough idea of the distance can be gained by the rate of regression of the feature in successive photos. Assuming a straight flight line, constant speed, and a picture taken every 2 miles, a feature to be visible in 10 consecutive pictures has to be 17.3 miles away when it appears in the center.

The most useful tool in getting the distance and direction of features from the photo nadir is a transparent templet (fig. 3). This templet was prepared by Edward S. Wood, Jr., and is

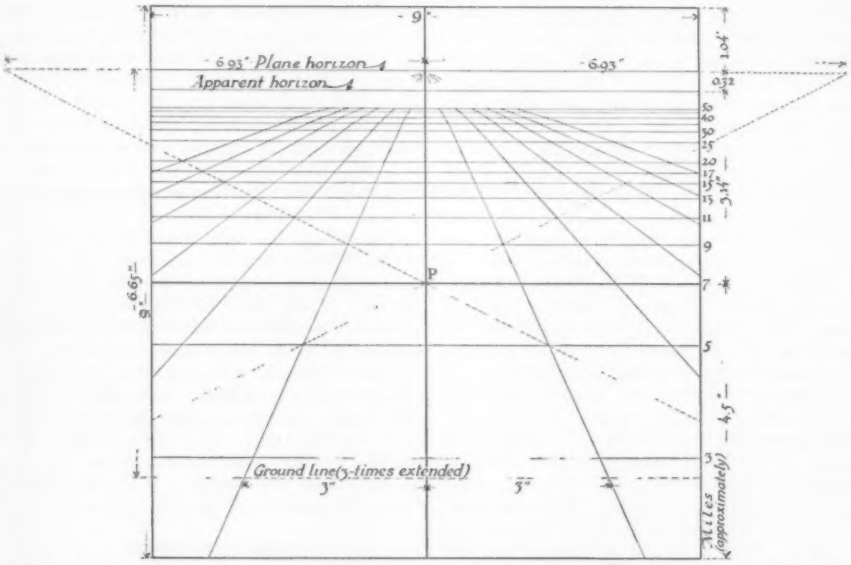

FIGURE 3.—Templet for trimetrogon side pictures, (elev. 20,000 feet, axial depression 30°). Lines of grid represent ⅛-inch squares on 1:1,000,000 scale map—close to 2 miles. Horizontal lines beyond 20 miles show the earth's curvature and refraction. (Prepared after the Canadian grid, by Edward S. Wood, Jr.)

TABLE I

Distance of objects in miles, by measuring how far they appear below the visible horizon trace. Object has to be within two inches of center, and the horizon trace has to be within one inch to 1.7 inch below the top of the photo.

Distance of object below the trace of horizon	Distance from plane in miles
1.14 inches	20
0.82 "	25
0.65 "	30
0.53 "	35
0.43 "	40
0.36 "	45
0.30 "	50

based on the assumption that the airplane is flying at 20,000 feet above average ground elevation and there is not too much tilt. If the horizon line is over 1.7 inches below the top of the picture, the templet should not be used. In the construction of the templet, the earth's curvature was not considered.

If the tilt of the plane is less than 2.7°, or the feature is not farther than 2 inches from the center line of the picture, the error from either source does not exceed 5 percent. Beyond 20 miles a simple scale drawn according to table I, which takes into account the earth's curvature and refraction, should be used to determine the distance to features. As each distant feature will appear in the center of one of the successive pictures, this scale is used even more often than the templet.

5. *Base map.*—The base map for final rendering is drawn on a scale 25 to 50 percent larger than publication size, usually at scales of 1:2,000,000 to 1:3,000,000, on good shrink-proof drawing paper. For the fine penwork the use of acetate and plastic sheets is not advisable.

The projection graticule should have quarter-degree intervals for proper allocation of features. The design of the map should provide space for the title, insets for political divisions and major landform divisions, a glossary, symbols, and a cartogram for relative reliability. All shorelines, roads, rivers, etc., are then penciled in from the 1:1,000,000 scale aeronautical charts. After some trials with colors, it was found that a black and white map was more satisfactory than one in colors. The reason for this is that the lettering has to be black to be readable. Landforms can be shown only in much lighter brown or gray, and thus much of the main feature of the map is lost. It is possible, however, to separate the hydrography and print it in blue.

6. *Drawing of landforms*—This is the main purpose of all previous work and it is not an easy task. The shapes and textures of the earth are infinitely variable, often extremely delicate, and usually not understandable to the average reader. They have to be symbolized and drawn so that the essentials of the pattern will be recognized. A rough guide to this procedure is given in *General Cartography.*[2] Mountains and hills are not so difficult, as they are strong and familiar forms. But when a mountain range is of contorted gneiss, criss-crossed by dykes and complicated by lava, the task is not so easy. Yet, often, the difficulty is with plains and plateaus. Inspection from an airplane reveals an infinite variety of patterns which do not show up on inspection from the ground. They are hard to symbolize and one often has to resort to short descriptions, lettered on the map.

7. *Reproduction.*—The best way to reproduce these maps is by offset in order to retain the delicacy of the fine ink lines. Often it is good to specify that the map should not be overexposed or inked heavily. If colors have to be separated, it is best to work with light blue "pulls." A base map is prepared in pencil, complete with hydrography, parallels and meridians, boundaries, cities, roads, insets—everything except the landforms. Lettering is laid out roughly and guide lines are added. From this, as many blue "pulls" are made as there are colors, using good drawing paper. Each color is inked separately, and the landforms are drawn directly on one of the blue "pulls." If the drawing is large, the paper should be mounted on metal.

LAND-TYPE MAPS

Desirable as good landform maps are, they are only one step in our quest for the

[2] *See* footnote 1.

map of the future. Vegetation and cultivation are just as much a part of the earth's pattern and, in a way, of more direct bearing on our lives than are landforms. There is no reason why the landform map could not be overprinted with yellow, green, and brown patterns for forest, grass, cropland, etc.

It is high time to break with the conventional layer tinting for medium- and small-scale maps with deceptive greens on the driest of deserts. Vegetation and cultivation are far more important than elevation above sea level, and if we follow in our symbolism the natural coloring we arrive at the *land-type* map, the map of the Air Age.

Library of Congress Gets First Mapping Camera Data

Complete calibration records of all T-11 cartographic mapping cameras produced by the Fairchild Camera and Instrument Corp. have been presented in bound volumes to the Library of Congress by the company's Vice-President in Charge of Military Liaison, Revere G. Sanders.

Mr. Sanders said this is the first time that complete optical calibration reports of aerial mapping cameras have been made a part of the public record in the library of Congress. Mr. Sanders said, "It is now possible for city engineers and individuals to fully utilize the T-11 photographs made by the Air Force, for accurate mapping purposes. Heretofore, necessary technical data has been unavailable to the civilian thereby preventing full utilization of thousands of aerial photographs of the United States."

The reports on individual cameras are exact duplicates of those supplied to the Air Force, for whom all of the cameras have been produced.

To supply this detailed calibration information, Fairchild had to install intricate, precise testing equipment. Previously, equipment of this type was in use in the United States only at the Bureau of Standards, and at its Canadian counterpart, the National Research Council.

Fairchild is also using an elaborately precise camera calibration setup for making reconnaissance aerial cameras more accurate.

Reprints of Articles

Reprints in quantities of 50 or more may be obtained of any article appearing in this issue. Orders must be placed with the Editor-in-Chief, Robert C. Eller, Topographic Division, U. S. Geological Survey, Washington 25, D. C., not later than 3 weeks after publication. Authors who wish reprints of their articles may so indicate when manuscripts are submitted. Approximate prices of 4- and 8-page reprints follow:

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1000	$21.30	$35.46	$64.09	$78.25

TRIANGULATION NETS LINKING MEXICO AND UNITED STATES

Coordination of the Triangulation Nets of Mexico and the United States

By MANUEL MEDINA

DIRECTOR "B," OFFICE OF GEOGRAPHY, MEXICO

THE TRIANGULATION networks of Mexico and the United States are coordinated by means of connections at four points. The first tie was made in 1916, immediately after the completion of the triangulation along the 98th meridian in Mexico, by the Mexican Geodetic Commission which was created in 1899.

This first geodetic connection was a quadrilateral with both diagonals observed. Two points of the figure were in Mexico and two in the United States. The observations were made simultaneously by Mexican and United States engineers, each group operating in its own country.

The most northern line of the Mexican triangulation along the 98th meridian is between stations COLOMBRES and TENACITAS, near the Mexico–United States boundary. To effect a connection with this Mexican line, United States stations DONNA and RIO of the Texas–California arc of triangulation were selected because they were visible from COLOMBRES and TENACITAS. Wooden towers, 60 feet in height, were used to elevate the instruments above the flat, tree-covered area surrounding the stations.

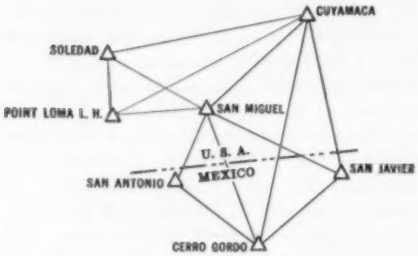
The Mexican geodesists, Ingenieros Silverio Alemán and Manuel Medina, used a Repsold and Sohn theodolite. This instrument has a 12-inch horizontal circle and the graduations are read by micrometers. The United States engineer, Capt. E. H. Pagenhart, used a 12-inch theodolite equipped with 3 micrometers by means of which the horizontal-circle graduations were read to single seconds of arc. Identical programs of observations were followed on both sides of the border. The direction method of observation was used, making from 12 to 16 pointings on each signal with both the direct and reverse positions of the telescope. All observations were made at night, pointing at acetylene signal lamps. When the observations were completed at each station, abstracts of the readings were exchanged, so that the triangle closures could be computed. The mean closure error of the four triangles was 0.56 second.

This first tie was very important to Mexico, because it permitted the computation of its triangulation on the North American Datum. It was also important because it made it possible to compare the length and azimuth of the same line as computed from the triangulation system of Mexico with that computed from the United States triangulation. The length comparison for the line COLOMBRES–TENACITAS showed a discrepancy of 0.10 meter, representing a relative error of 1/65,000.

The second tie between the triangulation nets of the two countries was made in December 1919, near the 117th meridian, across the boundary between California, U. S. A., and Lower California, Mexico. The geodesists who made this connection were Ingeniero Luis Urquijo of Mexico and Capt. C. V. Hodgson representing the United States.

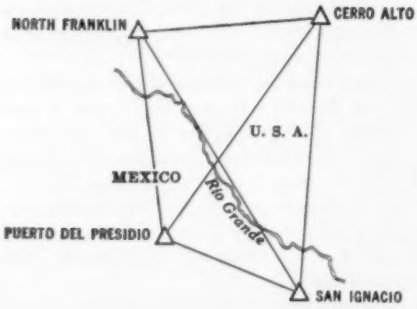
The stations in the United States were

CUYAMACA and SAN MIGUEL on the Texas–California arc. The stations in Mexico were SAN JAVIER, CERRO GORDO, and SAN ANTONIO. The geodesists of Mexico again used the Repsold and Sohn theodolite, and the United States geodesists used a 12-inch direction theodolite. The adjustment of this figure was made by the U. S. Coast and Geodetic Survey holding fixed the adjusted line CUYAMACA–SOLEDAD. The mean of the triangle closures was 1.21 seconds.



Between 1918 and 1931 several improvements in geodetic field equipment were introduced. Among these were: the replacement of the wooden tower by the Bilby portable steel triangulation tower; the development of the electric signal lamp; and the production of the optical type of theodolite, such as the Wild T-3.

The third tie between the triangulation nets was made in February 1931 near the 106th meridian. The geodesists who made this connection were Ingeniero Horacio Herrera for Mexico, and Lt. Ralph L. Pfau for the United States. The figure selected



for this tie was a quadrilateral with both diagonals observed. Stations SAN IGNACIO and PUERTO DEL PRESIDIO are in Mexico, and NORTH FRANKLIN and CERRO ALTO are the United States stations. The Mexican stations are part of a scheme of triangulation executed in Chihuahua, Mexico, by the Bureau of Geographic and Climatological Studies, the successor to the Mexican Geodetic Commission. The two stations in the United States are in the California–Texas arc of triangulation.

The third connection was made in the same general manner as the others with the following exceptions: The Mexican observers used the Wild T-3 theodolite and made 18 pointings; the United States observers used the Parkhurst 9-inch theodolite. No towers were required, for the stations were on top of fairly high mountains.

The fourth and last connection of the triangulation nets was made in January 1950. The Mexican geodesist was In-

geniero Glumar and the observing in the United States was under the direction of Lt. Comdr. Curtis LeFever of the U. S. Coast and Geodetic Survey.

The figure selected for the fourth tie was a quadrilateral with both diagonals observed, formed by stations FEELY and KELLY in the United States and stations BARRETA and BARROTE DEL 31 in Mexico.

The observing program was similar to

that used for the third tie. Towers were not required. The mean closure error of the triangles was 1.53 seconds. Comparison of the results of this last tie is important because the connecting lines in both triangulation systems are already adjusted, and are some distance removed from measured bases. The length comparison for the line BARRETA–BARROTE DEL 31 shows a difference of 0.19 meter, representing a relative error of 1/105,000.

These four ties are necessary to establish the triangulation system of Mexico rigidly on the North American 1927 Datum, the initial point of which is in the United States. At the present time the triangulation in Mexico is being extended southward and very soon a connection will be made to the triangulation in Guatemala. When this has been done, a continuous network of triangulation will be established on the North American continent extending from Alaska, through Canada, the United States, Mexico, and the Central American countries, and connecting to the South American triangulation in Colombia and Venezuela. Data concerning all stations in North America and Central America will be expressed on the North American 1927 Datum.

Although a part of the triangulation of Mexico that will be used to make a junction with the network in Central America was observed 40 or more years ago when instruments and techniques were different from those in use today, the foregoing account of the four ties between the United States and Mexico gives some indication of the accuracy that may be expected in the triangulation network between North America and Central America.

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Goodbye Blackboard

By BRUCE T. STANTON

COLLEGE OF FORESTRY, STATE UNIVERSITY OF NEW YORK, SYRACUSE, N. Y.

THE BLACKBOARD with its attendant chalk and dusty erasers has, for as long as most of us remember, been one of the symbols of the teaching profession and is still one of the primary tools of instruction. Today, however, more modern methods of visual presentation are rapidly replacing the use of this time-honored tool.

Visual aids in education vary in form, from wall charts and maps to elaborate color and three-dimensional motion pictures and televised presentations. Each of the many techniques has been designed to fit a particular set of circumstances and subject material, or has been advantageously adapted to that specialization. This paper discusses one such adaptation of a particular method of visual presentation to a specific type of instructional material.

Several years ago the author was confronted with the task of teaching a course in plane surveying to a class of 150 college sophomores. The problem of presenting the subject matter, with the necessary sketches, diagrams, forms, and other illustrative material, to so large a class caused considerable concern.

The customary blackboard was ruled out as completely inadequate for several reasons. A single sketch, many of which are necessary for an understanding of this type of subject matter, consumed practically all available board space if drawn sufficiently large to be seen at the rear of a room seating 150 students. The relative proportions of such sketches were by necessity distorted in order to be contained within the confines of a comparatively narrow horizontal band across the room. Letters and numerals made with ordinary chalk, although enlarged to four or five inches in height, appeared as fine hachures from the remote corners of the room. Even additional lighting of the board area failed to correct variations in visibility by introducing undesirable glare and highlights.

Quite naturally some means of projection appeared to be the only answer to the problem and several methods were considered.

The standard 3¼- by 4¼-inch slide projection was eliminated because of four specific shortcomings:

(*a*) The comparative high cost and relative inconvenience of slide preparation.

(*b*) The inevitable development of a "stereotyped" presentation, through lack of sufficient flexibility to meet changing conditions.

(*c*) The necessity of darkening the classroom sufficiently to produce a clear, sharp projection. This would curtail the taking of notes by the student and intensify the problem of adequate ventilation of the room.

(*d*) The operation of the projector, from a point at the rear of the room. This would deprive the instructor of the desirable opportunity to observe student reaction to, and reception of, the subject material.

Other projection systems, such as the Balopticon, Delineoscope, and 2- by 2-inch slides, were also abandoned for one or more of the reasons indicated above.

The problem has been happily solved through the use of an "overhead" type of transparency projector which avoids all of the objections found with other systems and is available under trade names as "Visual Cast" and "Vu-Graph." These devices are essentially alike in principle and design.

The "overhead" type of projector (*see* figure) consists of two fundamental parts: (1) A rectangular sheetmetal box which houses the 300- to 500-watt light source, a reflecting mirror, a series of condensing lenses, a stage plate, and a cooling system; and (2) a system of projection lenses and another mirror supported about 18 inches above the stage plate. The magnification of the instrument is variable from approximately 6:1 at a projection distance of 6 feet to 15:1 at 16 feet. The equipment is quite portable and requires only a source of electricity and a projection surface, either

(*Courtesy Charles Beseler Co.*)

PORTABLE TRANSPARENCY PROJECTOR

a screen or an unobstructed wall space.

In operation, transparencies are the most satisfactory media for projection, although opaque material may be projected in silhouette. A sheet of clear acetate or plastic can be placed upon the stage and, by using a wax pencil of the china-marking type, drawings, sketches, and all the mathematical formulas can be developed for the student in a progressive manner. Photographs, from 35 mm. to 10 inches square, either color or black and white, may be projected and the essential elements can be pointed out on the photo, instead of at the screen, by the instructor.

A desirable degree of animation can readily be obtained by changing the position of one acetate sheet carrying details superimposed on a basic drawing. This method has been particularly successful in explaining the theory of the magnetic compass and in the discussion of a variety of transit verniers. The student is better able to visualize the relative motions of the different parts of the instruments and consequently comprehends the technique of their operation more rapidly and logically.

Overlays of previously prepared material may be built up to as many as ten sheets of acetate, depending upon the weight employed. Six thicknesses of 0.010-inch-thick acetate have been very satifactorily used without serious effects upon the focus of the projected image. By the use of special transparent inks, or through the use of a commercially developed printer, color may be introduced very effectively in drawings. Experiments in dichromatic projection and viewing of anaglyphs indicates that three-dimensional projections of difficult topics are not only possible but entirely feasible.

By using a specially prepared type of thin acetate, material such as tables, examinations, bibliographic references, and so on, may be prepared and presented quickly and inexpensively by typing directly on the projection acetate which involves no further processing.

The advance preparation of drawings, overlays, graphs, tables, and examinations is far less expensive and time consuming than in most other projection methods. This preparation requires no special equipment, darkroom, or processing except when photographic material or color is employed.

The fact that the instructor can constantly face his class and observe how the material is being received, plus the fact that satisfactory projections are obtainable in a normally lighted room enabling the student to take notes, are features that are difficult to evaluate but are unquestionably desirable. This method also develops a personal re-

lationship that is lacking in other methods of projection. After using this projector a very short time the instructor completely ignores the projection and has the distinct feeling that each and every student is watching over his shoulder as he might do were the problem being presented in the privacy of the instructor's office.

Interruptions "to erase the board" are avoided completely by simply removing the acetate from the stage and continuing on another sheet. If desirable, a continuous roll of acetate material may be employed and unused clean acetate brought onto the stage by turning a small crank, much in the same manner as winding the film in a camera after an exposure is made.

Problems, sketches, or any other data that may have been developed during the course of the lecture may be returned to the screen to summarize by merely replacing the particular acetate on the stage.

In depicting forms, as standard field notes, the headings and ruled lines can conveniently be prepared prior to the class by ordinary drafting-room methods using regular India drawing ink. These forms can be filled in during the lecture by use of wax pencil. Subsequently, at the instructor's leisure, these entries can be removed without detriment to the original inked form by wiping with carbontetrachloride. Should it be necessary to change the form, water will remove the ink leaving the acetate clear for redrawing.

Subject matter developed during the course of the lecture need not be marked "save" or "do not erase," thus depriving the next instructor of valuable working space. The acetate is merely retained and projected at the next class meeting when the discussion is continued. Short daily examinations can be made efficiently without demanding valuable class time to write the questions on the board and avoiding the more costly alternative of a duplicating process to supply each student with an individual question sheet.

The general reaction of over 400 students who have been instructed with the aid of this projector has been very favorable, several volunteering a wish that its use were more widespread, particularly in large classes where considerable scientific data is presented.

The flexibility of use, and the many variations of projection techniques that may be employed with this projector, furnish a constant challenge to the instructor to make better and more meaningful presentations of his subject material.

This paper has been based on experience in dealing with one subject, but its application to many fields and subjects that require considerable explanation by the instructor can readily be seen, particularly in those classes numbering in excess of 25 or 30 students. Subject matter in geometry, trigonometry, physics, chemistry, and geology can very effectually be offered in this manner, while possibilities in art subjects, as well as botanical sciences, are unlimited.

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International Cooperation on Cartography With Particular Reference to the United Nations

By DR. TE-LOU TCHANG

BEFORE DEALING with the main subject, it is necessary to clarify the standing of this question in the framework of all existing international organizations in the field as well as in that of the United Nations itself.

In the first place, international cooperation on cartography has a long and outstanding record; for instance, the International Association of Geodesy was established as early as 1887. There are now a number of scientific organizations like the American Congress on Surveying and Mapping which deal with various cartographic subjects. The International Union of Geodesy and Geophysics, the International Geographical Union, the International Hydrographic Bureau, the International Society of Photogrammetry, and the Pan American Institute of Geography and History are among the most active. Even within the family of the United Nations, the International Civil Aviation Organization coordinates the publication of the World Aeronautical Charts and the Food and Agricultural Organization is particularly concerned with world land-use maps and soil maps. The World Health Organization, the World Meteorological Organization, the Universal Postal Union, and the International Telecommunications Union publish world maps for special purposes suited to their own use. I am only concerned here with the United Nations' activities.

In the second place, while national professional societies, private enterprises, and international scientific organizations have all made essential contributions in developing cartographic activities and in advancing the associated techniques, the actual surveying and mapping of an area are the responsibility of the government or governments concerned; the United Nations' activities in this sphere are related to international promotion and coordination. In this connection, it may be of interest to point out that the main task of the United Nations is to fill gaps in international cooperation wherever they exist. There is no question of the United Nations interfering with or duplicating the work of any of the existing national and international organizations.

Finally, cartography as such is only one item among the multitude of questions involved in economic and social development, which, in turn, constitute only a small part of all the questions of worldwide importance with which the United Nations deals. In many instances some relationship exists between cartography and other technical questions. Therefore, a thorough study of the United Nations' activities on cartography will lead to the study of many projects under such other headings as technical assistance.

U. N. INTEREST IN MAPPING

It may be asked why the United Nations should have so great an interest in surveying and mapping. The best answer can be found in Article 55 of the Charter of the United Nations, the first part of which reads as follows:

Article 55.—With a view to the creation of conditions of stability and well-being which are necessary for peaceful and friendly relations

Presented at the Thirteenth Annual Meeting of the American Congress on Surveying and Mapping, Washington, D. C., March 23–25, 1953. Three footnotes have been added to complete the information on the action taken by the Economic and Social Council at its fifteenth session.

Dr. Tchang is the Acting Chief of the Cartographic Office, Department of Social Affairs, United Nations. The views expressed in this article are strictly the author's own and do not necessarily reflect those of any organ of the United Nations.

among nations, based on respect for the principle of equal right and self-determination of peoples, the United Nations shall promote: (*a*) higher standards of living, full employment, and conditions of economic and social progress and development; (*b*) solutions of international economic, social, health, and related problems, and international cultural and educational cooperation, and. . . .

Thus, the United Nations' interest in mapping is not merely for the map itself nor is it for the development of cartographic science and techniques from an academic standpoint. The ultimate objective of the United Nations in furthering international cooperation on cartography is "the promotion of social progress and better standards of life in larger freedom"—to use the original wording of the preamble of the Charter. The fundamental steps to this end are the development of natural resources and of social planning for which cartographic data constitute, in most cases, the basic information indispensable for an intelligent and efficient approach. Failure to seek adequate cartographic data before launching these projects may result in very serious consequences. In fact, some important projects have turned out to be failures for this very reason.

Another question will logically follow: What are the general means that are available to the United Nations for dealing with subjects in the economic and social fields which cover cartography, and what are the procedures that the Secretary-General has observed in implementing the specific resolutions relating to cartography?

With respect to the first item, the Economic and Social Council is the competent organ of the United Nations whose sphere of interest includes cartography. The United Nations Charter stipulates in Article 62 that with respect to economic and social questions and related matters, the Economic and Social Council may initiate studies or reports. It may make recommendations to the General Assembly of the United Nations, to members of the United Nations, and to the Specialized Agencies concerned. It may prepare draft conventions for submission to the General Assembly and call, in accordance with the rules and procedures of the United Nations, international conferences on matters within its competence.

In accordance with Article 98, the Secretary-General of the United Nations acts, in his capacity of chief administrative officer of the Organization, in all meetings of the various organs of the United Nations and performs such other functions as are entrusted to him by these organs, including the Economic and Social Council.

The manner in which each resolution is implemented by the Secretariat, inasofar as its responsibility is concerned, depends upon the nature and scope of the work to be carried out. If a study involves a policy decision that concerns governments, the Secretary-General may invite them to make observations and recommendations. In a study of a purely technical nature, views and comments of individual experts may be sought. When the question is of importance and requires thorough discussions, the Secretary-General may call a committee of experts to make a study and to offer suggestions. The findings of international scientific organizations working in the field are also taken into account. In this connection, mention may be made of the Committee of Experts on Cartography called in 1949, in which all the interested specialized agencies of the United Nations and international scientific organizations participated; namely, the International Civil Aviation Organization; the Food and Agriculture Organization; the World Health Organization; the United Nations Educational, Scientific and Cultural Organization; the International Hydrographic Bureau; the International Union of Geodesy and Geophysics; the Pan American Institute of Geography and History; the American Congress on Surveying and Mapping; and the International Society of Photogrammetry. The main task of the Committee was to submit proposals for carrying out the Council's first resolution on cartography. Most of the recommendations made by that Committee were later approved by the Council.

USE OF NON-GOVERNMENTAL CONSULTANTS

Regarding non-governmental organizations it may be of interest to point out what provision is made in the Charter concerning the participation of these organizations in the work of the United Nations. The answer is in Article 71 which reads as follows:

> The Economic and Social Council may make suitable arrangements for consultation with non-governmental organizations which are concerned with matters within its competence. Such arrangements may be made with international organizations, and, whenever appropriate, with national organizations after consultation with the member of the United Nations concerned.

Present arrangements make provision for two categories of consultative status: Category A includes organizations having a basic interest in most activities of the United Nations and Category B, those concerned specifically with only a few of the fields of the activity covered by the Council. For the organizations which are highly specialized in a narrow field and which have a significant contribution to make to the Council and its subsidiary bodies but for which Status A and B are not appropriate, a register of organizations in consultative relationship was established by the Secretary-General under Resolution 288 (X) of the Council, passed on 27 February 1950.

In the various economic and social fields, over 200 organizations have consultative relationship with the United Nations. In the field of cartography, the International Union of Geodesy and Geophysics, the International Geographical Union, and the International Association of Geodesy are among those on the register.

In this connection it is encouraging to note the very fruitful cooperation on the part of the various international scientific organizations connected with cartography. It is obvious that an organization like the United Nations cannot deal with highly specialized problems in this field in an advantageous manner, unless the experience of international organizations of long standing which are active in the field is fully used. All the international organizations mentioned above have made useful contributions to the United Nations. For instance, the Pan American Institute of Geography and History prepared a study on modern cartographic methods, the International Association of Geodesy and the International Society of Photogrammetry also contributed to the Cartographic Bulletin, and the deliberations of the International Geographical Union and of the Pan American Consultation on Cartography supplied useful suggestions for several studies made by the Secretariat of the United Nations.

Having studied the role played by organizations, it is natural to consider the services that may be rendered by individual experts. Since the branches of cartography are so numerous, a great number of experts are needed to deal with problems relating thereto. A Panel of Consultants has been constituted in accordance with the recommendations of the Council. Most of the cartographically advanced countries have proposed, for inclusion in the Panel, lists of their nationals who are experts in the various fields of cartography in which the United Nations might call individually for counsel on specific problems. The provisional Panel of Consultants already contains more than 200 such names. A reference to a specific contribution made by some of these experts will be made later.

ACCOMPLISHMENTS

Now the heart of the subject has been reached, i.e., United Nations' achievements. In this respect also, limitations of space require the review to be very brief and selective. More detailed information can be found in the United Nations documents to which appropriate reference is made herein.

The question of international coordination on cartography was first brought before the United Nations by the Delegation of the United States of America during the early days of the United Nations. The question was first considered by the Economic and Social Council in February 1948. Further consideration has been given to the matter from time to time either under a specific

item on cartography or during the discussion of related subjects. The agenda of the fifteenth session of the Council, which opened on 31 March 1953, included two items connected with cartography.

One of the most important actions that the Economic and Social Council has taken in this field is the fostering of cartographic activities throughout the world so that every country may have at its disposal the necessary maps and other related data for economic and social development projects. The Council has repeatedly recommended to governments that they stimulate the accurate surveying and mapping of their national territories and that they develop close international cooperation in the field, particularly with their neighboring countries. As a result, many governments, members and nonmembers of the United Nations, have forwarded at regular intervals, reports on the activities and achievements in this sphere, which show that good progress has been made. Reports from Argentina, Brazil, Burma, Canada, France, Thailand, United Kingdom, and United States of America, are contained in Volumes I and II of the United Nations' Cartographic Bulletin, "World Cartography."

In supporting this action, other steps have been taken by the Council. On the one hand, the Secretary-General of the United Nations was requested to further efforts of the governments in this undertaking by promoting the exchange of technical information and by other means, including the preparation of a study on modern cartographic methods and the development of uniform international standards.[1] The Secretary-General was also requested to develop close cooperation with the cartographic services of interested member governments, to coordinate the plans and programs of the United Nations and specialized agencies, and to offer assistance in the coordination of the programs of interested international organizations. On the other hand, consultations with governments were undertaken concerning the convening of regional conferences on cartography to be attended by representatives of governments having a common interest in a specific region. This was based on the recommendations of the Committee of Experts on Cartography mentioned above. These conferences are to be called following a pattern similar to that of the Pan American Consultation on Cartography, sponsored by the Pan American Institute of Geography and History. Six regions were proposed; namely, Asia and the Far East, Central and South Africa, the Middle East, Western Europe and the Mediterranean, Eastern Europe, and the Americas. Regarding the last region, it should be pointed out that the Pan American Consultations on Cartography have been held regularly every two years. The fifth General Assembly of the Pan American Institute of Geography and History, held at Santiago, Chile, in 1950, has requested the United Nations to recognize the Fifth Pan American Consultation on Cartography as the first United Nations Regional Cartographic Conference for the Americas. In turn, the Sixth Pan American Consultation on Cartography held at Ciudad Trujillo, Dominican Republic, invited the President of the Commission on Cartography of the Pan American Institute of Geography and History to extend full cooperation to the Secretary-General of the United Nations in the implementation of any resolution which the Council may adopt in this connection.

The Secretary-General's report[2] on regional cartographic conferences based on the replies so far received from twenty-six governments, members and nonmembers of the United Nations, was submitted to the

[1] At its fifteenth session, the Economic and Social Council adopted a resolution requesting the Secretary-General of the United Nations to consult with governments and appropriate intergovernmental organizations on the adoption of a standard method of writing geographical names on maps.

[2] The Economic and Social Council took note with satisfaction of the report and requested the Secretary-General to continue consultations with governments and appropriate inter-governmental organizations and to submit a report to a future session.

fifteenth session of the Economic and Social Council in United Nations document E/2362. It is interesting to note that no opposition to the principle has been registered and most of the governments have expressed favorable views on such conferences. The government of India offered to act as host for the Asia and Far East Conference.

TECHNICAL ASSISTANCE PROGRAM

Technical assistance to governments by the United Nations provides one of the most effective means for encouraging national cartographic activities. The work is being carried out under the program known as "Expanded program of technical assistance for economic development of under-developed areas" or in short "Expanded program of technical assistance." Technical assistance in economic development was decided upon by the General Assembly of the United Nations in December 1948 and was enlarged to the present form in 1949. At that time, work along these lines was under way in the United States and was known as the "Point Four" program.

Without going into the details of the operation of the program, which has many similarities with the Point Four program, I shall confine myself to stating that it is a cooperative undertaking of the United Nations and its specialized agencies and is supported by 65 nations, including 12 nonmembers of the United Nations. Under this program, three principal forms of assistance can be given to those governments who make the request: (*a*) expert assistance; (*b*) fellowships and scholarships; and (*c*) equipment. Some hundred projects have been completed, or are being carried out, or are under study in the various fields of economic and social development. Insofar as cartography is concerned, experts on geodesy, topography, and geological maps are now working in several countries of the Middle East. The sending of experts on photogrammetry and map reproduction and the provision of photogrammetric plotting machines for Southeast Asian countries are being studied. Scholarships in photogrammetry were awarded to technicians for studying this subject in well-advanced countries. It is encouraging to point out that many governments have included cartographic work in the first phase of their program for economic development. The importance of cartography is thus given further affirmation.

INTERNATIONAL MAP OF THE WORLD

An activity of the United Nations in furthering international cooperation for a specific item is related to the International One-Millionth Map of the World. It will be recalled that this project was established in 1909 in Paris and in 1913 in London by International Map Conferences. This map, which comprises nearly 1,000 sheets for the land areas of the world, is a long-term international project. The work twice suffered interruption because of world wars. Thus far, about 400 sheets have been published and many of them need to be brought up to date. Since the Second World War, international activity in the project has not yet regained the required development and on the suggestion of several governments, the Council in 1949 requested that a study be made on the desirability of the integration of the Central Bureau, International One-Millionth Map of the World, into the United Nations. In September 1951, after consideration of the Secretary-General's report on the subject, the Council recommended the transfer of the functions of the Central Bureau to the United Nations Cartographic Office and invited the Secretary-General to make recommendations on means of furthering the completion of the International Map. In undertaking the study, the Secretary-General has called upon the advice of experts from countries of various parts of the world, selected from the Panel of Consultants mentioned above, and has taken into consideration the deliberations of such international organizations as the International Geographical Union and the Sixth Pan American Consultation on Cartography. One of the recommendations which appears in the report concerns the revision of the specifications governing the publication of the map. The report,

issued as United Nations documents E/2376 and E/2376/Add.1, was also on the agenda of the fifteenth session of the Economic and Social Council.[3] As to the carrying out of the transfer, negotiations with the President of the Central Bureau are in progress. An interim report of the Secretary-General, tracing developments thus far, was also submitted to the Council and is contained in the United Nations document E/2366 as Annex III.

U. N. CARTOGRAPHIC PUBLICATIONS

In order to satisfy the need for the exchange of technical information, the Annual Bulletin, "World Cartography," contains four main sections: General Questions; Technical Studies and Notes; Reports on Activities; and a Bibliography. The Report of the Committee of Experts, together with a study on modern cartographic methods, all mentioned above, were contained in a United Nations' publication under the title, "Modern Cartography, Base Maps for World Needs."

LOOKING AHEAD

The above is only a very brief outline of the major activities of the United Nations in the field of international cooperation on cartography. It has stressed the fact that substantial progress is being made in stimulating surveying and mapping by governments. This progress has a special significance in view of the tremendous responsibility that the United Nations has to assume in international affairs, especially during a period in which international political uncertainty has not been eliminated and in which budgetary limitations on economic and social projects still prevail.

The United Nations' action in this field constitutes only a starting point of the undertaking; the extent to which results can be expected is finally in the hands of governments and of all those who are concerned with cartographic projects—from policy-making officials to the technicians who carry out the work. The essence of international cooperation in cartography entails goodwill and constructive action not only on the basis of government with government, but also of people with people. In this field, as in other spheres of activity, the United Nations will be what it will be given the opportunity to be.

[3] The Economic and Social Council took note with satisfaction of these reports. The Secretary-General was requested to continue to maintain close liaison with responsible national cartographic agencies and interested international organizations for the purpose of furthering the completion of the International Map. The Secretary-General was also requested to prepare proposals for amending the existing specifications governing the publication of the map in order to bring them into line with modern requirements.

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Golf Course in Form of Map

A MEMORIAL miniature golf course for children, in the form of a map of the United States, honoring the late Frederic A. Delano, the uncle of former President Franklin D. Roosevelt, has been proposed for the Washington, D. C., park system.

The proposal was put forward by Horace W. Peaslee, a Washington, D. C., architect, who worked with Mr. Delano for many years, writing in the current issue of the *Journal of the American Institute of Architects.*

Mr. Peaslee said Mr. Delano was personally interested in having such a project for the Washington park system, for Mr. Delano had just such a miniature map on the ground at his home, Algonac, near Newburg, N. Y., on the Hudson River, looking down to Storm King Mountain.

There, with his grandchildren, he played miniature golf. He said that, by playing on this map, they got a better appreciation of the United States.

One foot on the proposed map would represent 4 miles, so the entire project would be 750 feet long. Major cities could also be shown.—*The Evening Star,* Washington, D. C., Oct. 15, 1953.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

General Interest

A METHOD FOR SETTING OUT BATTER PEGS. G. S. Aplin. *The Australian Surveyor,* Vol. 14, Nos. 3–4, September–December 1952. (Notes on a practical aid to surveyors on engineering construction projects.)

THE MAP OF THE NINETEEN COUNTIES AND THE EARLY TRIGONOMETRICAL SURVEYS OF N. S. W. *The Australian Surveyor,* Vol. 14, Nos. 3–4, September–December 1952. (Interesting and entertaining history of the survey of New South Wales from 1828 to 1850).

THE HYDROGRAPHIC DEPARTMENT OF THE ADMIRALTY. Commander G. S. Ritchie. *Empire Survey Review.* Vol. 12, No. 87, January 1953, "History and Organization." Vol. 12, No. 88, April 1953, "The Compilation of an Admiralty Chart." Vol. 12, No. 89, July 1953, "The Royal Navy Surveying Service." (Comprehensive picture of the functions of the Admiralty Hydrographic Department in three installments.)

CADASTRAL SURVEYING'S "JOHNNY APPLESEED." Marin N. Nance. *Our Public Lands,* Vol. 3, No. 2, April 1953. (Note about a deputy public land surveyor in 1863 who planted tree seeds in the witness pits at the corner marks of the land he was surveying near the confluence of the Yakima and Columbia Rivers in Washington Territory.)

HARDY CROSS OF YALE RETIRES; PRACTICAL MAN AND PHILOSOPHER. (News item.) *Engineering News-Record,* Vol. 150, No. 22, May 28, 1953. (Tribute to a famous professor of civil engineering.)

CHANGING THE MAP OF THE SOVIET UNION. George B. Cressey. *Economic Geography,* Vol. 29, No. 3, July 1953. (Commentary on the physical changes brought about by the Soviet fifth 5-year plan.)

SURVEY OF SALARIES FOR CIVIL ENGINEERING POSITIONS. *Civil Engineering,* Vol. 23, No. 7, July 1953. (Report of ASCE Committee on Salaries, Spring 1953.)

HOW TO MEASURE STATE INTEREST IN AGRICULTURAL ROADS. G. A. Riedesel, Highway Research Engineer. *Engineering News-Record,* Vol. 151, No. 13, Sept. 24, 1953. (Method used by State of Washington to define and measure State interest in its highways in order to determine equitable appropriation of funds.)

Cartography

EVOLUCION DE LA CARTOGRAFIA; CARTOGRAFIA DE UN MUNDO NUEVO. Ing. Geogr. Don Pablo Ihl C. *Revista Geographica de Chile,* Vol. 6. No. 8, February 1953. (Compact discussion of the development of world cartography and its relationship to geographical knowledge.) (In Spanish.)

LA CARTOGRAFIA CHILENA. Teniente Coronel don Mario Torres Poblete. *Revista Geografica de Chile,* Vol. 6. No. 8, February 1953. (Historical survey of surveying and mapping in Chile from earliest times.) (In Spanish.)

A NEW CONFORMAL PROJECTION FOR EUROPE AND ASIA. O. M. Miller. *The Geographical Review,* Vol. 53, No. 3, July 1953. (Mathematical description of a projection for Europe and Asia devised by the American Geographical Society for the Army Map Service.)

ARE MOUNTAINS ENOUGH? Edward L. Ullman. *The Professional Geographer,* Vol. 5, No. 4, July 1953. (Points out that cartographers in compiling standard atlas, wall, and base maps tend to place too much emphasis on mountains as barriers to movement and tend to ignore or fail to delimit other important barriers such as desert and semi-arid lands.)

PERCENTAGE DOT MAPS. J. Ross Mackay. *Economic Geography,* Vol. 29, No. 3, July 1953. (Discussion, based on study of preferences of students using economic distribution maps, of the advantages of the percentage dot map over the common dot map.)

RURAL ROAD INVENTORY; JOINT COUNTY-STATE COMPREHENSIVE STUDIES. *California Highways and Public Works,* Vol. 32, Nos. 7, 8, July–August 1953. (Detailed

report of project for comprehensive survey of all roads in California and descriptions of the three series of maps and their uses, being produced for each county in the State.)

AN OBLIQUE EQUAL AREA MAP FOR WORLD DISTRIBUTIONS. Allen K. Philbrick. *Annals of the Association of American Geographers,* Vol. 43, No. 3, September 1953. (Demonstrates usefulness of Sinu-Mollweide oblique projection as compared with other interrupted projections.)

GEOGRAPHIC FACTORS AND CARTOGRAPHIC PROBLEMS IN LONG RANGE AND REGIONAL MAPPING PROGRAMS. Robert Lee Wyener. *The Professional Geographer,* Vol. 5, No. 5, September 1953. (Comprehensive survey of problems, both domestic and worldwide, which complicate the attainment of the goal of adequate mapping and subsequent revision.)

INTERRUPTING A MAP PROJECTION; A PARTIAL ANALYSIS OF ITS VALUE. Arthur H. Robinson. *Annals of the Association of American Geographers,* Vol. 43, No. 3, September 1953. (Compares values of deformation in various projections, interrupted and uninterrupted forms.)

MOUNTAINS ARE NOT ENOUGH. William H. Parker. *The Professional Geographer,* Vol. 5, No. 5, September 1953. (Further comments on subject discussed by Dr. Ullman in previous issue of *The Professional Geographer* also listed here.)

"POINTILLISM" AS A CARTOGRAPHIC TECHNIQUE. George F. Jenks. *The Professional Geographer,* Vol. 5, No. 5, September, 1953. (Discusses both the difficulties and advantages of "pointillism," or the technique of juxtapositional color mixtures in cartographic representation of economic or other distributions.)

THE RELIEF MAP. Joseph E. Williams. *The Professional Geographer,* Vol. 5, No. 5, September 1953. (A comparison of various devices for showing relief on maps and a plea for more study of the problems involved in order to arrive at more standardization of principles and procedures.)

TOWARD A UNITY OF CARTOGRAPHICAL FORMS AND GEOGRAPHICAL CONTENT. Allen K. Philbrick. *The Professional Geographer,* Vol. 5, No. 5, September 1953. (The author suggests and discusses ten principles common to both the fields of cartography and geography which suggest the complementary nature of both.)

Control Surveys

GROUND-PHOTOGRAMMETRY IN AUSTRALIA. Dr. Ing. G. J. Stasser. *The Australian Surveyor,* Vol. 14, No. 3–4, September–December 1952. (Discusses application of ground photogrammetric methods to preparation of precise large-scale plans of dam sites and areas for power stations.)

GEODETIC WORK IN MEXICO FROM MAY 1950 TO APRIL 1951; *and* GEODETIC WORK IN MEXICO FROM MAY 1951 TO MARCH 1952. Manuel Medina Peralta. *Transactions American Geophysical Union,* Vol. 34, No. 1, February 1953. (Two brief technical reports translated for the *Transactions* by F. L. Culley.)

RELATIVE GEOIDAL UNDULATIONS FROM DEFLECTIONS OF THE VERTICAL. Carl I. Aslakson. *Transactions American Geophysical Union,* Vol. 34, No. 1, February 1953. (Highly technical but of interest to students. Discussion of the phenomena involved in causes of deflections from observed determination of the vertical measurement.)

FIRST-ORDER SURVEY PIN-POINTS CONSTRUCTION ACROSS TAMPA BAY. *Civil Engineering,* Vol. 23, No. 7, July 1953. (Difficulties encountered and successful solutions to problem of providing accurate horizontal control across 11 miles of open water.)

STRENGTH OF FIGURE FOR TRILATERATION. Chi-san Shu. *Transactions American Geophysical Union,* Vol. 34, No. 4, August 1953. (*Abstract:* An investigation of five figures commonly used in shoran trilateration resulted in numerous values expressing the relative accuracies obtainable using these figures. Triangles and quadrilaterals are examined for various shapes, while the semi-hexagon, hexagon, and square are examined fixed in shape but with different locations for the fixed lines.)

Education

STATE HIGHWAY DEPARTMENTS FALL SHORT OF ENGINEERING PERSONNEL NEEDS BY 15%. (Survey.) *Engineering News-Record,* Vol. 150, No. 26, June 25, 1953. (Much of blame for situation placed on inequality and inadequacy of salary scales.)

A UNIVERSITY PRESIDENT LOOKS AT ENGINEERING EDUCATION. Robert G. Sproul, President, University of California. *Civil Engineering,* Vol. 23, No. 6, June 1953. (Excerpt from address at ASCE San Francisco Convention. "The American pattern of engineering education has long been admired for its ingenuity, imagination, and flexibility. Yet there is continuing concern for its improvement . . . toward getting the engineering student down from the girders and onto the platform with Sophocles and Goethe.")

SURVEYING INSTRUCTION AT THE UNIVERSITY. Peter N. Ray. *Empire Sur-*

vey Review, Vol. 12, No. 89, July 1953. (Author attempts to assess the merits of the surveying instruction given in the universities of Great Britain and to suggest possible ways in which they may be improved.)

Instruments

SURVEYOR'S COMPASS. Notes from the Franklin Institute Museum. *Journal of the Franklin Institute*, Vol. 255, No. 6, June 1953. (Historical note on an early 19th century instrument made by Benjamin Rittenhouse.)

MEASUREMENTS OF TEMPERATURE OF GEODETIC SURVEYING TAPES. J. S. Clark and L. O. C. Johnson. *Empire Survey Review*, Vol. 12, No. 89, July 1953. (Recommends use of a resistance thermometer made of invar tape and situated in the neighborhood of the measuring tape for determining the mean temperature of the latter when working in the bright sunlight.)

SPECIAL EQUIPMENT DEVELOPED FOR SURVEYING IN FLORIDA EVERGLADES. *Civil Engineering*, Vol. 23, No. 7, July 1953. (Report on equipment and techniques employed in surveying one of the most difficult areas in the United States for development of a flood control project.)

COMPASS MAKERS TO THE NAVY ROYALL. W. E. May. *Nautical Magazine*, Vol. 170, No. 2, August 1953. (Interesting historical account of British instrumentmakers of the late 17th and early 18th centuries.)

Property Surveys

FOREST INVENTORY. Division of Forestry, Region 1, Bureau of Land Management. *Our Public Lands*, Vol. 3, No. 3, July 1953. (Compares efficiency of forest inventory by aerial photography with the old methods of timber cruising on foot.)

SURVEYS FOR RESOURCE DEVELOPMENT. William R. Bandy. *Our Public Lands*, Vol. 3, No. 3, July 1953. (Brief account of the intensive cadastral survey and resurvey program being pushed in the Missouri River Basin.)

BOOKS AND PAMPHLETS

PRINCIPAL SYMBOLS, PATTERNS, AND COLOURS IN COMMON USE ON GEOLOGICAL MAPS AND FIGURE ILLUSTRATIONS. Canada, Dept. of Mines and Technical Surveys, Geol. Surv. of Canada, Ottawa, 1951, 21 pp., illus., sample maps.

THE PREPARATION OF VISIBLE AREA MAPS BY FIELD SKETCHING. R. W. Chorlton. Canada, Dept. of Resources and Development, Forestry Br., Forest Research Div., Forest Fire Research Note No. 16, Ottawa, 1951, 16 pp., sketches, diags., bibliog. (Information and methods on preparation of visibility maps for planning a detection system for forest fire controls.)

REPORT OF THE CHAIRMAN OF THE UNITED STATES DELEGATION TO THE VI PAN AMERICAN CONSULTATION ON CARTOGRAPHY OF THE PAN AMERICAN INSTITUTE OF GEOGRAPHY. Consultation held at Ciudad Trujillo, Dominican Republic, October 12 to 24, 1952. (18 p. processed.)

A METHOD OF ESTIMATING TIMBER VOLUMES FROM AERIAL PHOTOGRAPHS. Miles J. Ferree. State University of New York, College of Forestry, Syracuse 10, New York, 1953. 50 pp., illus., $1.00. (Description of a new approach to inventorying timber lands with the aid of vertical aerial photographs.)

ELEMENTS OF CARTOGRAPHY. Arthur H. Robinson. New York. *J. Wiley & Sons*, 1953, 254 pp. Maps. (Reviewed in this issue.)

MAGNETIC OBSERVATORY MANUAL. U. S. Coast and Geodetic Survey Special Publication No. 283. 232 pp. Washington, *Government Printing Office*, 1953. For sale, Superintendent of Documents, $1.50. (Special chapters of interest to surveyors.)

UNITED STATES ATLASES, VOLUME 2. The Library of Congress. Compiled by Clara Egli LeGear. Washington, 1953. xiii and 301 pp. Superintendent of Documents, *U. S. Government Printing Office*. $2.25.

LYMAN D. LYNN

DISTINCTIVE RECENT MAPS

For the reader's convenience, the addresses of publishers and prices of maps are given where this information is available.

—EDITOR

The United States and World Affairs is the title of a new (1953) wall map published by Rand McNally and Company. It was edited by Prof. Stephen Jones of Yale University. The map is laid out on the north polar azimuthal equidistant projection at the scale (along meridians) of one inch to 331 miles. Countries of the world are

grouped by color into three groups as follows: (*a*) the United States and possessions, other NATO countries, Latin American nations, Pacific Pact nations, and dependent areas under NATO control are identified with various shades of green; (*b*) territories of the Soviet Union and Communist nations in Europe and Asia under Soviet control have red tints; and (*c*) unattached nations and territories controlled by unattached nations are colored yellow.

A symbolic sphere identifies members of the United Nations and a crown marks the members of the British Commonwealth of Nations. A list of Great Metropolitan Centers (over one million population) and a table of great circle distances fill insets. The map measures 42 by 46 inches.

Miscellaneous Publication No. 15254 of the Hydrographic Office, U. S. Navy Department, 1953, presents a chart of the world on twelve sheets, each of which measures approximately 33 by 36 inches. Two additional sheets give longitude scales for the chart which is on the Mercator projection. Equatorial scale is 1:12,233,000. International boundaries shown are those recognized by the United States prior to 1938, with unsettled boundary claims subsequent to that date being indicated by broken lines. The grid includes lines for each degree of latitude and longitude. Time clocks for each 15 degrees of longitude are placed along the top and bottom margins.

A revised edition (second) of the world map showing *Immigration Quota Areas According to the Immigration and Nationality Act of the United States* was published in 1952 by the U. S. Government Printing Office, from data supplied by the State Department. "Quota Areas" and "Asia-Pacific Triangle Quota Areas" are delimited. "Immigration Quotas Under the Immigration and Nationality Act" are given in a table on the right margin of the map. Detailed descriptions giving "Boundaries of certain quota areas," and a black and white map of the "Asia-Pacific Triangle" occupy the verso of the sheet. The map, which is on the Miller cylindrical projection, measures 10½ by 30 inches and has an equatorial scale of 1:60,000,000.

Plate 9, of the American Geographical Society's "Atlas of Diseases," is entitled *Study in Human Starvation 2. Diets and Deficiency Diseases.* Six maps occupy the plate. Map 1 shows world distribution of "Selected Nutritional-Deficiency Diseases." A generalized pattern of diets for the world is shown on map 2. "Distribution of Vitamin Deficiencies, South America" is the title of Map 3. Similar areas are outlined for Africa on Map 4, and for South Asia on Map 5. "Diets of Selected Primitive Tribes" is the title of Map 6.

The present plate, prepared like previous ones under the direction of Dr. Jacques May, "represents a compilation of the essential official and unofficial data contained in more than 300 books and papers." Most of these works are listed in the bibliography which is printed on the verso of the map sheet. Plate 8 (previously published) and Plate 9 present the essential facts in the geography of human starvation. Dr. May amplifies this thesis in an article entitled "The Mapping of Human Starvation, Diets and Diseases," which was published in the July 1953 number of the *Geographical Review* (pages 403–404).

A *Stamp Map of the World,* in two colors, was copyrighted in 1951 by the Philatelic Institute, Cambridge 39, Mass. Designed and drawn by Ernest Dudley Chase, prolific pictorial map artist, the Stamp Map comprises an outline map of the world with reproductions of various national stamps placed within the limits of the issuing country and around the sheet margins. Historical and descriptive notes relating to stamps and stamp collecting occupy open ocean spaces. Map measurements are 21½ by 33 inches. No scale is indicated.

The Americas, at the scale of 1:12,500,000, is a reduction, on one sheet, of the map of the Americas (1:5,000,000) published by the American Geographical Society in five sheets, between 1942 and 1948. The 1:12,500,000 scale map was compiled by the American Geographical Society for the Army Map Service, and published by the latter in 1953. The map, which shows generalized relief by hypsometric tints, measures 51½ by 34 inches. Small inset maps show "Cities and Transport," "Agricultural Land Use," "Moisture Regions," and "Natural Vegetation."

United States Population Distribution, Urban and Rural: 1950 is the title of the Census Bureau's map based upon the recent census. Four classes of urban areas are distinguished by appropriate red symbols. Black dots show distribution in rural areas. The map is available in two sizes, a small one at the approximate scale of 1:5,000,000, measuring 24½ by 38 inches, and a large size at the scale of 1:3,200,000 which measures 38½ by 60 inches.

The Coast and Geodetic Survey, U. S. Department of Commerce, recently issued nautical chart 898 which covers the Gulf Intracoastal Waterway from Stover Point to Port Brownsville, Tex.

The new chart completes the series of 34 nautical charts (Nos. 865 through 898) which were designed to provide large-scale coverage of the entire Gulf Intracoastal Waterway from Carabelle, Fla., to Brownsville, Tex. Chart 898 was compiled from topographic and hydrographic surveys by the Coast and Geodetic Survey with revisions and additions from other sources. Terrain details adjacent to the waterway are charted. Marshlands are indicated by a green overprint and the Intracoastal Waterway route is shown as

a red line. Lights, beacons, buoys, and dangers to navigation are corrected for information received to date of issue. The chart is printed on paper measuring 26 by 38 inches and is at the scale of 1:40,000. Copies of the new chart are distributed by the sales agents, district offices, and the Washington office of the Coast and Geodetic Survey. Price is 50 cents per copy.

Ghost Towns of the Old West are located on a map which embraces the States of Arizona, California, and Nevada. Adorned with scenes suggestive of the Old West, the map includes 34 ghost towns in California, 25 in Nevada, and 27 in Arizona. The map, which measures 16 by 22 inches, was copyrighted in 1952 by John D. Lawrence, and published by Marvel Maps, 1410 North Stanley Ave., Los Angeles, Calif.

A three-dimensional plastic relief model of Washington State was published in 1953 by the Aero Service Corporation, Philadelphia 20, Pa. It carries the title *Washington Territorial Centennial 1853–1953.* The map is small, 6½ by 9 inches. Hypsometric layer tints accent the embossing in showing relief.

The State Geological Survey, Vermillion, S. Dak., published in 1953 a new *Geologic Map, State of South Dakota.* It was compiled by Bruno C. Petsch under the direction of E. P. Rothrock, State Geologist. The map measures 27½ by 43 inches and is at the approximate scale of 1:580,000. Formations ranging in age from pre-Cambrian to Cenozoic are mapped.

Arkansas Mineral Resources 1950, was published by the Division of Geology, Arkansas Resources and Development Commission (Little Rock, Ark.). Deposits of twenty-three different minerals ranging from glass sand to diamonds are located. For each of these there is also a brief descriptive paragraph. "Arkansas Mineral Production for 1951" is given in a statistical table. The map measures 21 by 24 inches and is at the approximate scale of 1:1,000,000.

A map showing *Virginia Mineral Resources* was compiled by Byron N. Cooper and Richard V. Dietrich of the Geology Department, Virginia Polytechnic Institute, and published in 1953 by the Virginia Engineering Experiment Station. It is at the scale of 1:500,000 and measures 27½ by 60 inches. The map is available, at one dollar per copy, from the Director, Engineering Experiment Station, Virginia Polytechnic Institute, Blacksburg, Va.

Thoroughbred Farms of Virginia are located on a map published in 1952 by the Virginia Horsemen's Association (Warrenton) with the cooperation of the Virginia State Chamber of Commerce. More than 380 farms are located on the map and listed by owner's name, farm name, and location. Major concentrations in Loudoun, Fauquier, Albemarle, and Clarke counties are shown on enlarged inset maps. The map is illustrated by Wesley Dennis. It measures 21 by 26½ inches and is at the scale of 1:1,300,000.

A colorful *Route Map of the Coronation of Her Majesty Queen Elizabeth II,* was published in 1953 by Master Maps, Ltd., of England. The map embraces the portion of London through which the Coronation Procession passed, and the various landmarks and buildings are pictorially depicted. Coats of arms decorate the border of the map as well as the margins of the verso. The latter also includes a brief descriptive sketch as well as portraits and the genealogical table of the Royal Family.

A map of *Ireland* showing generalized relief, as well as roads, railroads, political boundaries, and other cultural features, has been compiled and printed by the Ordnance Survey of Ireland, and published by the Director at the Ordnance Survey Office, Phenix Park, Dublin, Ireland. There are small inset maps of Dublin, Belfast, and Cork. The scale is 1:500,000 and the dimensions 36½ by 26 inches. Relief is indicated by contours and graduated color tints.

Deutschland im Jahre 1789 Staats- und Verwaltungsgrenzen portrays the internal political and administrative boundaries of the lands now comprising Germany, during the period of the Holy Roman Empire. The map was compiled by Professor Dr. Gunther Frank for the Acadamie für Raumforschung und Landesplanung. It was printed in 1952 by Atlantik-Verlag Paul List of Frankfurt, Hamburg, and München. This large colored map is at the scale of 1:1,000,000 and is printed on two sheets each measuring 52 by 30 inches.

The Direccion General del Turismo [Spain] released in 1951 a *Mapa de las Principales Carreteras de España.* It is at the scale of 1:1,750,000 and measures 23 by 30 inches. Two classes of roads, inhabited places and administrative centers, hotels, resorts, and recreation centers are mapped.

The electric power network of Spain is mapped at the scale of 1:750,000 on a map published in 1952 by Dirección General de Industria, Ministerio de Industria, Madrid, Spain. It carries the title *Mapa de las Instalaciones de Producción, Transporte y Subestaciones de Transformación de Energia Eléctrica.* Existing and projected installations and transmission lines are shown. The map is printed on four sheets each measuring 26½ by 32½ inches.

A railroad map of Jugoslavia (*Zeleznicka Karta Jugoslavia*) at the scale of 1:800,000, was published in 1952 by Glavna direkcija Jugoslovenskih Zeleznicka. The map, which measures 35 by 40 inches, has on its right and left margins an alpha-

betical list of railway stations keyed to locations on the map. Several classes of railroads, "in operation," "in construction," and "projected" are indicated. A number of inset maps show details of the railroad pattern in and around the major urban centers.

Israel Map of Communications presents the latest (revised to April 1, 1952) road and railroad information for that country. It shows also international boundaries, armistice lines, airports, antiquity sites, and towns and villages. A table gives distances from Jerusalem, Tel Aviv-Jaffa, and Haifa to various other inhabited centers. The map, which is at the scale of 1:300,000 was compiled and drawn by Zvi Friedlander and printed in 1952 by the Kfar Monash Press in Haifa.

The United Nations Technical Assistance Mission of Afghanistan published in 1953 a map of *Afghanistan* showing generalized relief by color gradations. International and provincial boundaries, cities, airfields, railroads, roads, and water features are also shown. The map is at the scale of 1:2,000,000 and measures 21 by 22½ inches.

The Survey of India has issued a new edition (corrected up to May 31, 1952) of its *Railway Map of India*. It is at the scale of 1:4,250,000 and measures 30 by 39 inches. Boundaries of major political subdivisions are indicated in addition to the rail network.

A rail transportation map of India has also been compiled by Ondez (India), Post Box 6212, Bombay 10, India, and printed at Western India Art Works, Bombay. It is entitled *Indian Union Showing Railway Systems*. Appropriate symbols classify systems as to broad, medium, or narrow gauge. A comprehensive "Index to Towns" fills the border areas of the map sheet. The map scale is 53 miles to the inch and the measurements are 41 by 34 inches.

Two new maps have recently been published under the direction of the Surveyor General of Pakistan. *Pakistan Showing Political Divisions* includes separate maps of West Pakistan, East Pakistan, and Junagadh and Manavador all at the scale of 1:3,168,000. Railroads, roads, trade routes, and political boundaries are indicated. A small inset map shows "Pakistan and Surrounding Countries." The political map of Pakistan was originally issued in 1950, and the present edition, the second, was published in 1953. The map measures approximately 24 by 28½ inches.

The *Route Map of Pakistan* was published in 1952 by the Survey of Pakistan, Murree. It shows roads and railroads of several classes, including some under construction, pack tracks, telegraph lines, cities, towns, and villages, hotels and rest houses, and petrol filling stations. A small inset map traces steamer services in East Pakistan. The scale and dimensions are the same as for the political map.

An *Ecological Map Showing Major Vegetation and Grazing Zones of the Anglo-Egyptian Sudan* was issued in 1952 by the Sudan Survey Department, Khartoum. "Desert," "Acacia-desert scrub," "Swamp," "Woodland-grass savannah," and "Forest" areas are distinguished. Suggested locations of grassland experimental centers are also given. The scale of the map is 1:8,000,000 and the approximate dimensions are 17 by 10 inches.

New information on Mozambique is available in two recent maps of that Portuguese colony. Generalized geology is shown on the map entitled *Esboço Geológico e Litológico*, prepared under the direction of Alexandre Borges. It was printed in 1949 by Imprensa Nacional de Moçambique. Some 17 different formations, ranging in age from "primitive" to Quaternary are defined.

Província de Moçambique, Rede de Estradas Classificados, shows the rail and road network of the colony. Several classes of routes are indicated. Internal administrative centers and boundaries are also shown. This map was published in 1951, also by the Imprensa Nacional. Both maps are at the scale of 1:2,000,000 and measure 38 by 24½ inches.

H. E. C. Robinson, Ltd., 221–3 George St., Sydney, New South Wales, Australia, has published a new *Political Map of Oceania and Indonesia Showing Territories and Sphere of influence of Each Nation*. Principal mail and trade routes are given and major economic products are listed for different regions. The map is on the Mercator projection with an approximate scale of 1:14,000,000. It is printed on two sheets, each measuring 39½ by 30 inches.

—WALTER W. RISTOW

ARTICLE DESCRIBES ACSM ANNUAL MEETING

The ACSM 13th Annual Meeting was fully described in the 1953 issue of the Bulletin Géodésique recently published by L'Association Internationale de Géodésie in Paris. The 19-page article, written by ACSM member J. Vance Dobbin, gave a short summary of each paper delivered at the meeting.

Books in Review

THE PRINCIPLES AND PRACTICE OF SURVEYING, VOLUME II, HIGHER SURVEYING (Seventh Edition). Charles B. Breed and George L. Hosmer. *John Wiley & Sons,* New York. 1953. 675 pp. $7.00.

(This book was reviewed by Prof. Philip Kissam in the July–September 1953, issue of SURVEYING AND MAPPING. Prof. Eyman's review, below, approaches the book from a somewhat different point of view and is published in the interest of providing a forum for the expression of differing opinions.—Ed.)

Previous publications on surveying by these authors have long been recognized by the profession as setting high standards in the subject. Accordingly, they have attained wide usage as textbooks in many schools and colleges. This new edition promises to maintain its place on the high level of its predecessors.

It should be stressed that, for student use, a text should be clear, concise, and directly to the point. There should be as little digression or unnecessarily involved mathematical gymnastics as consistent with a lucid understanding, and all formulae should be absolutely correct. All demonstration problems and figures, or diagrams, should closely follow the explanations given in the text and, above all, be free of errors or terms whose presence cannot be readily identified. All symbols and abbreviations should be uniform throughout and multiple use of the same character with different meanings should be scrupulously avoided. Appropriate tables, or excerpts therefrom, for all special terms or constants used in problem work should be appended with suitable notations.

With the above general specifications in mind, the following comments are directed to a certain few shortcomings in the present edition. It may be noted, parenthetically, that most of these remarks apply equally well to earlier editions. (Other textbooks also exhibit many similar weaknesses, but usually without the better qualities of this book.)

In addition to some few revisions, the Seventh Edition has added a number of new articles on several types of surveying—modern methods of astronomical computations, barometric leveling, photogrammetry, etc. — which are certainly timely and generally well presented. On the other hand, there is very little that has been dropped or noted as outmoded — it appears rather that a definite effort has been made to retain, so far as practicable, the same format. This may be a desirable feature from the publication standpoint but certainly not at the expense of the omission of badly needed corrections and alterations. Chapter I, for instance, has been retained intact, although in this writer's opinion, a number of changes, some of which will be listed below, are highly desirable.

Article 49, "Computation of Geodetic Positions," could be much simplified and improved by closer adherence to the policy stated in the preface to the First Edition. This policy, among other things, states: "It is not the intention in any sense to present a treatise on Geodesy." To be sure, the formulas outlined in this article are far from complete geodetic determinations, but the method of presentation lends itself largely to that view although the derivations are discontinuous and incomplete, and hence, I may add, rather frustrating to a neophyte. Inasmuch as there are footnotes stating that such derivations, together with the applicable constants and appropriate tables, may be found elsewhere in certain publications, it would seem much better to condense the text to a mere statement of the formulae with brief explanations and the appended footnotes. Other departures into somewhat similar semi-complete geodetic determinations are to be found in the discussions of grid coordinates and special projections. For example, two and one-half pages are devoted to the derivation of the X-coordinate for the Transverse Mercator projection, whereas the Y value is summarily dismissed with the remark that this distance "may be computed by formulas given in most textbooks on Geodesy." A rather inconsistent and less than helpful procedure, this.

The presentation of the Transverse Mercator projection, its development and uses, is all too brief and inadequate. The statement that it "is the ordinary Mercator projection turned at right angles" is not technically correct and apt to be misleading. An extra diagram or two at this point would be enlightening. The treatment given the Lambert conformal projection is somewhat better, especially when article 424 is considered in conjunction with article 54 (d). (Why not combine both articles in one?) The modern trend is to inculcate in surveyors the many advantages to be gained from the use of coordinates based on statewide grid systems (one or the other of the above projections). It

would seem desirable, therefore, to devote much additional space, supplemented by several clear diagrams, to a more complete description of these projections with full notes on how or where all the coordinates may be obtained.

In connection with these X- and Y-coordinates, why are the usual concepts of such directions, east and west and north and south respectively, reversed in formulas, 9, 10, and 11 on page 72? They are then shown in the conventional manner on page 76 (except that the formula for Y, in feet, is in error). This lack in uniformity is rather disconcerting to the student. Another lack in uniformity, or rather a uniformity where it is not warranted, is in the numbering of figures 29, (a) through (j). Since these refer to about four entirely different subjects, it would seem that renumbering the whole seriees would be better practice.

The revision of methods of astronomical computations is generally very good. More diagrams of the navigational astronomy type would be helpful. Several errors in the problem work should be corrected and the use of terms apparently taken from "tables," not otherwise identified, should be explained.

Photogrammetry is rapidly gaining in general use and the newer instruments and procedures are undergoing continual improvement. It is well, therefore, for a modern text to attempt to keep pace with these changes, which the present work does.

Much more could and should be included about modern hydrographic methods with the omission or considerable condensing of some of the obsolescent means. Electronic devices for determining depth and position have been constantly developed and perfected in recent years such that subaqueous data in both shallow and deep water can be obtained with great accuracy and speed. The description of the recording strip would be greatly clarified if supplemental cuts or sketches or portions of fathograms were included.

These comments are not intended to convey the impression that this volume is an inferior product. If some of the criticism seems a bit harsh it is with the thought of awakening in authors the necessity of keeping the ancient art of surveying fully up-to-date and not permit it to stagnate in a simple "rehash" of earlier writings. It is hoped that these remarks will be received as constructive criticisms in order to make the Eighth Edition, if and when it is published, a truly outstanding work on the subject.

RAYMOND P. EYMAN
George Washington University

THE ELEMENTS OF ASTRONOMY FOR SURVEYORS. The late R. W. Chapman, M. A., B. C. E., Fellow of the Royal Astronomical Society and formerly Professor of Engineering, the University of Adelaide. Fifth edition, revised and enlarged by J. B. Mackie, M. Sc., B. E., A. O. S. M., A. M. I. M. M., A. M. N. Z. I. E., F. G. S., Senior Lecturer in Surveying, Otago University, New Zealand. Published by *Charles Griffin and Co., Limited*, 42 Drury Lane, London WC 2, England. Price 26s. 245 pages.

This is the latest edition of a standard text which has been in considerable demand since the first edition was published in 1918. As stated in the preface, the book was intended to provide an elementary work suitable for the student and for the surveyor who is taking astronomical observations for the first time. To achieve this objective, it was desired to explain not only the practical methods of observing and computing, but also the principles which the surveyor must thoroughly understand, without going as deeply into the mathematical derivation of the formulas as is generally done in the theoretical textbooks on astronomy. That the book succeeds, is attested by the fact that five impressions were made of the fourth edition.

In 1950, the British Admiralty and the U. S. Naval Observatory revised and standardized their respective Nautical Almanacs and also collaborated with agencies of other countries to produce, under the auspices of the International Astronomical Union, tables of "Apparent Places of Fundamental Stars" which are published annually by *Her Majesty's Stationery Office*, London. In addition, the Admiralty has recently published a new set of astronomic tables titled "The Star Almanac for Land Surveyors." These changes in the form of the basic information upon which the land surveyor depends in calculating astronomic observations have rendered many of the older texts somewhat obsolete and motivated the fifth revision of this text. Mr. Mackie seized the opportunity to introduce certain new and useful material.

The book opens with an explanation of the basic principles of spherical trigonometry required for the solution of spherical triangles. It next describes the concept of the celestial sphere and the two systems of coordinates used to define the positions of the celestial bodies. Separate chapters are devoted to the earth, the sun, time, the location of objects on the celestial

sphere, and astronomical and instrumental corrections to observations of altitude and azimuth. These are followed by chapters on the determination of true meridian, latitude, time, and longitude. At this point, Mr. Mackie has inserted a new chapter on the simultaneous determination of latitude and longitude by the line-of-position method. This is a subject, long familiar to the navigator, which has been somewhat overlooked by the surveyor. It is becoming of increasing interest in the field of reconnaissance mapping. The book closes with a short chapter on the subject of convergence of meridians.

This book is a clearly written exposition of the principles of field astronomy. The language is simple and direct and the explanations are detailed. Although many of the examples are illustrative of observations made in the southern hemisphere, the authors have been careful to point out differences in procedure required for observations north of the equator. Mr. Mackie has introduced many new examples to replace those of the earlier editions which had become obsolete.

HENRY D. WALKER
U. S. Geological Survey

ELEMENTS OF CARTOGRAPHY. Arthur H. Robinson (University of Wisconsin). *John Wiley & Sons,* New York. 1953. 254 pages, 185 illustrations, 38 tables. $7.00.

Elements of Cartography is a unique contribution to the field of American cartography. It appears at a period in the development of American cartography when relatively few works on the subject have been published in English. Cartography in the United States, in contrast to that in Europe, has flourished in practice with little support in basic theory. Academic research leading to sound principles has been neglected while the mad rush to produce more maps has continued unabated. Cartography was given a particular impetus in the United States during World War II when production soared in order to fulfill the Herculean demands for maps. It was during this period and in the postwar years that small- to medium-scale cartography truly reached a significant level. Production techniques and procedures were developed rapidly, many patterned after the large-scale mapping techniques already in practice. The leading role played by the author in this development gave him the practical background for research in the long-neglected aspect of the field, namely, the basic theory and principles that support the science of modern cartography.

This book is primarily a textbook for a first course in cartography at either graduate or undergraduate level for students in geography or related fields. It is directed toward the basic principles and theories that support small- to medium-scale maps and their compilation, design, and constructional features. The introductory chapter, in which the basic theory of cartography is explained, orients the reader in a most effective manner and introduces him to a practical approach to the science and art of cartography. The mathematical basis for cartography is adequately treated, with emphasis on the selection and use of map projections rather than their construction. Drafting techniques, equipment, and materials are described in sufficient detail to offer the reader a basic understanding of the construction phase of map making. It is in the chapters on map compilation, design, lettering, and symbolization that the author truly rates attention. Here, for the first time, drafting versus cartography are placed in their proper relationship: "The art and science of cartography is based primarily on intellectual and visual skills, not on manual skills." Here, also, basic rules in cartography are probed and explained for the first time. The critical problem of generalizing data when compiling from large to small scale is particularly well treated. The book concludes with a chapter on representation of terrain in which a thorough study is made of techniques and styles both historical and in current practice.

Several suggestions are offered for consideration at the time a revision may be contemplated. The general topic of map scale deserves more attention so that the student entering the field of cartography may be made positively aware of its several and far-reaching ramifications. Technical terms used for the first time should be explained, and more emphasis on the preparation of maps for offset lithography would be desirable. Finally, plastics as a drafting and map-reproduction medium are of prime importance and deserve more recognition as they apply to current cartographic practices.

The wealth of illustrations in the book is worthy of note. Their effectiveness lies in the simplicity with which they are designed and constructed. Each figure tells a story simply

and effectively—the author practices what he preaches.

Numerous statistical tables in the Appendix make the book an excellent reference volume in the field of general cartography. A selected bibliography of references in English support the research and offer the student and the professional cartographer an opportunity to perform further study. A bibliography of selected foreign publications would have enhanced the book as a reference volume.

As a text and reference volume, this book is a welcome addition to the field of cartography. It treats both the practical and theoretical phases of map making, and, probably most important, it suggests new avenues of research that require attention.

ROBERT J. VOSKUIL

Vienna, Virginia

NOTE SUR LE CALCUL DES GRANDES GÉODÉSIQUES. J. J. Levallois and M. Dupuy. *Publications Techniques de l'Institut Géographique National, Ministère des Travaux Publics, des Transports et du Tourisme,* Paris. 1952. 83 pp., 11 tables and illustrative examples. For sale at: Service des Cessions des Cartes de l'I.G.N., 107 Rue La Boétie, Paris (8e). Price: 2400 francs.

Recent and prospective developments in electronic surveying, long range guided missiles, aerial navigation, and related fields, are creating demands for refinements in the practical solution of the two fundamental and classical problems of the science of geodesy: (1) Given the starting point, azimuth (direction), and length of a geodesic (shortest line) on the earth's surface, to find the position of the end point; and (2) the inverse problem, i.e., given the end points, to define the path and find the length of the shortest line connecting these two points. The accuracy of the solution to these problems, is, first of all, limited intrinsically by our knowledge of the size and shape of the earth. Postulating these data, there remains the question of the accuracy needed in a specific problem and of the economics of the computation, including such factors as type of personnel and computing machinery available, speed required, etc. The authors attempt to meet these demands by presenting a variety of solutions involving a variety of tabulations which are appended to the volume. The present book represents an elaboration of ideas presented in an article by these authors which appeared in the June 1950 issue of the "Bulletin Géodésique" published by the "Association Internationale de Géodésie." As an introductory summary, free from computational distractions, this article recommends itself for an evaluation of the scope and purpose of the present volume.

Chapters I to III review the fundamental properties of the ellipsoid of revolution and discuss the differential equation of the geodesics on this surface. The practical solution of this equation, which leads to an elliptic integral, is the problem which the authors propose to solve. One notable feature of their treatment is the use of Wallis integrals in the series expansion of the elliptic integrals instead of the Fourier expansions favored by Jordan, Helmert, and others. Another is the mapping of the spheroid on the sphere circumscribed at the equator by means of the so-called reduced or parametric latitudes, rather than projection on an osculating sphere as developed, for instance, by A. R. Clarke. The former transformation preserves azimuths and radii of revolution and enables one to solve the problems of spheroidal trigonometry on the sphere. Chapter III deals with the consequences of this transformation.

Chapter IV discusses the general theory of successive approximations and applies the method in the solution of a direct and an inverse numerical problem involving a line 5,000 kilometers in length. In Chapter V we find extensive computations for 5 lines of varying lengths to various degrees of accuracy illustrating the use of the tables, some of which are for use with any spheroid, while others are dependent on the parameters of the spheroids of Bessel, Clarke 1880, and Hayford (International). No supplementary tables are included for specific use with the Clarke 1866 spheroid on which our North American triangulation is based and which, the most recent investigations indicate, approximates the geoid more closely than was believed earlier in the century.

Chapter VI is devoted to the typical problem of shoran, or electronic, surveying: to determine the position of a point defined by its distances to two known points and to solve the spheroidal triangle thus formed. The last chapter discusses the Andoyer-Lambert formula, used extensively in this country in shoran and loran computations, and suggests a modification to increase the accuracy if needed.

An over-all evaluation of the various methods presented here is difficult unless applied to a specific problem confronting the computer. This

difficulty arises from the nature of the subject of computation. Certainly, from a computational point of view, this is the most extensive and valuable contribution on the subject to date, representing, as it does, the combined experience of two distinguished geodesists and geographers and of the Institut Géographique National. The authors claim no particular originality aside from their use of the Wallis integrals, confining themselves, as they state, to developing the consequences of representing the expansion of elliptic integrals in terms of these elegant integrals.

On the debit side it seems necessary to mention that the format is not up to the requirements of a mathematical text. Presumably, careless proofreading has left a number of misprints in spelling and figures, such as the transposition in ΔM at the bottom of page 39. We are all conscious of the economies exacted by government printing requirements, but there is no excuse in a mathematical formula for ambiguities such as exponents that look like coefficients or compound fractions which in effect are written $a \div b \div c$.

ERWIN SCHMID
U. S. Coast and Geodetic Survey

Library of Congress Catalogs

THE Library of Congress has recently reorganized the pattern of its catalogs published in book form. These catalogs have hitherto been published under the titles *Library of Congress Author Catalog* and *Library of Congress Subject Catalog*. Hereafter, one publication, the *Library of Congress Catalog*, will be published in five separate parts with the following subtitles: *Books: Authors; Books: Subjects; Films; Maps and Atlases;* and *Music and Phonorecords*.

The *Catalog* has long been a valuable reference tool for libraries, schools and other institutions, and business firms. Each issue contains bibliographical data reproduced from the Library of Congress catalog cards printed during the period covered by that issue. The cards represent materials cataloged by the Library of Congress and by other United States libraries that participate in a cooperative cataloging program.

The section subtitled *Maps and Atlases* will be arranged geographically and will contain both author and subject indexes. It will be issued semi-annually with annual and quinquennial cumulations.

Institutions or individuals may subscribe to any or to all of the parts of the *Library of Congress Catalog*. Single copies of any one issue also will be sold. Inquiries about prices should be addressed to the Card Division, Library of Congress, Washington 25, D. C.

New Journal of British Photogrammetric Society

WITH the publication of the first two numbers of its official journal, *The Photogrammetric Record*, the Photogrammetric Society of Great Britain has brought forth an important addition to the periodical literature of photogrammetry.

The first two issues of the semi-annual publication contain the following principal items:

Vol. 1, No. 1, March 1953.—Negative Exposure in Air Photography, by G. C. Brock; A Test for Systematic Error in Aerial Triangulation, by Prof. E. H. Thompson; Mapping from High Altitude Photography, by J. A. Eden; Seventh International Congress of Photogrammetry; Book Reviews and Notes; and Correspondence.

Vol. 1, No. 2, September 1953.—The Value of Air Photographs in the Analysis of Drainage Patterns, by S. H. Shaw; Lens and Film Resolution, by R. W. Fish; The Use of the Cambridge Stereocomparator for Air Triangulation, by H. A. L. Shewell; and Book Reviews and Notes.

Correspondence regarding this publication should be addressed to the Photogrammetric Society, c/o Department of Civil and Municipal Engineering, University College, Gower Street, London, W.C.1, England.

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. Authoritative articles covering this class of information are solicited. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession.

—EDITOR

Topographic Maps

THE FOLLOWING quadrangle maps were published by the U. S. Geological Survey between June 1 and August 31, 1953. All maps are available with or without the green overprint which indicates woodland. The quadrangle name is shown in capital letters, followed by the county name in upper- and lower-case letters. Since many quadrangle maps extend into several counties, only that county name is given which contains the place for which the quadrangle is named. For example, the quadrangle DUNAWAY MOUNTAIN, in *Alabama,* is in parts of St. Clair and Etowah counties, but only St. Clair is shown because the feature Dunaway Mountain is in that county.

The topographic maps listed below show the shape and elevation of the land surface (represented by contour lines, printed in brown); water features (in blue); works of man, including cities, towns and scattered habitations, schools, churches, railroads, roads, and boundaries (in black); and woodland areas (in green). Principal roads are shown by a red overprint. In areas that have been covered by General Land Office Surveys, township and section lines are shown. The State Rectangular Coordinate Systems are indicated in the margins of the maps. An information folder further describing topographic maps and symbols is available on request.

Standard quadrangle maps may be obtained for 20 cents per copy. A discount of 20 percent is allowed on orders amounting to $10 or more at the retail price. Orders should be addressed to the U. S. Geological Survey, Washington 25, D. C. (or Denver 15, Colo., for maps of areas west of the Mississippi River).

Alabama

DUNAWAY MOUNTAIN—St. Clair
EASTABOGA—Talladega
FRANCIS MILL—Calhoun
GLENCOE—Etowah
JACKSONVILLE*—Calhoun
MUNFORD—Talladega
OHATCHEE—Calhoun
SEALE—Russell
WELLINGTON—Calhoun

Alaska

GULKANA (B-4)*—Third Judicial Division†
GULKANA (B-5)*—Third Judicial Division†
GULKANA (B-6)*—Third Judicial Division†
GULKANA (C-6)*—Third Judicial Division†
GULKANA (D-5)*—Third Judicial Division
TALKEETNA MOUNTAINS (B-3)*—Third Judicial Division†
TALKEETNA MOUNTAINS (C-1)*—Third Judicial Division†
TALKEETNA MOUNTAINS (C-2)*—Third Judicial Division†
TALKEETNA MOUNTAINS (C-3)*—Third Judicial Division†
TALKEETNA MOUNTAINS (C-4)*—Third Judicial Division†

Arizona

ANTELOPE PEAK*—Pinal
YUMA EAST—Yuma

Arkansas

CANFIELD—Lafayette
FOUKE NE—Miller

Arkansas-Louisiana

BRADLEY—Lafayette
BRADLEY SE—Lafayette
DODDRIDGE—Miller

California

BUTTE CITY—Glenn
CAMPBELL MOUND—Tehama
CHICO*—Butte
COLUMBIA*—Tuolumne
DOZIER—Solano†
EMIGRANT CANYON*—Inyo†
EUREKA*—Humboldt†
FILLMORE—Ventura†
GILSIZER SLOUGH—Sutter†
HYAMPOM*—Trinity†
MATILIJA—Ventura†
OJAI—Ventura†
PALEN MOUNTAINS*—Riverside†

* Indicates 15-minute quadrangles; all others are 7½-minute quadrangles.
† Indicates map lies wholly within county named.
‡ Indicates availability in either a contour or a shaded-relief edition.

PETERS—San Joaquin
PIRU—Ventura†
RICHARDSON SPRINGS—Butte†
RICHARDSON SPRINGS NW—Tehama
STOVEPIPE WELLS*—Inyo†
TORRANCE—Los Angeles†
TUOLUMNE*—Tuolumne
VAL VERDE—Los Angeles
WAUCOBA MOUNTAIN*—Inyo†
WEST OF BIGGS—Butte

Colorado

ATWOOD NE—Logan†
FORT MORGAN—Morgan
GOLDEN—Jefferson
HORSE CREEK—Adams†
MORRISON—Jefferson†
OMAR—Weld

Connecticut

BRIDGEPORT—Fairfield†
CLINTON—Middlesex
MIDDLE HADDAM—Middlesex†
NORWALK SOUTH—Fairfield†

Florida

ALTHA WEST—Calhoun
FORT KISSIMMEE—Highlands
GREEN COVE SPRINGS—Clay
HESPERIDES—Polk
KEUKA—Putnam
LAKE PLACID—Highlands†
MARIANNA—Jackson†
SEBRING—Highlands†

Florida-Alabama

CAMPBELLTON—Jackson
SILLS—Jackson

Georgia

BUENA VISTA—Marian†
BUENA VISTA NE—Marian†
CATAULA—Harris†
GENEVA—Talbot
LOUVALE—Stewart
LUMPKIN SW—Stewart†
MULBERRY GROVE—Harris†

Georgia-Alabama

FORTSON—Muscogee

Illinois

ASSUMPTION*—Christian

Indiana

CARMEL—Hamilton
CUMBERLAND—Marion
FARMLAND—Randolph
FISHERS—Hamilton
MAJENICA—Huntington
MAXVILLE—Randolph†
McCORDSVILLE—Hancock
SEELYVILLE—Vigo†
SWITZ CITY—Greene

Indiana-Kentucky

ROCKPORT—Spencer

Iowa

AFTON*—Union

Kansas

AUBURN*—Shawnee†

Kentucky

ASHBROOK—Anderson
BEREA—Madison
BLACKWATER—Laurel
BRYANTSVILLE—Garrard
BUCKEYE—Garrard
CHAPLIN—Nelson
DANVILLE—Boyle
DINGUS—Morgan
ELLISBURG—Casey†
FANCY FARM—Graves
HALLS GAP—Lincoln†
HARRODSBURG—Mercer
HIMA—Clay
KELLY—Christian†
KIRKSVILLE—Madison
LEWISBURG—Logan†
LOVELACEVILLE—Ballard
MAYFIELD—Graves†
McBRAYER—Anderson
MILBURN—Carlisle
NICHOLASVILLE—Jessamine
PAINT LICK—Garrard
PARIS EAST—Bourbon†
POMEROYTON—Menifee
PORTERSBURG—Clay
RUSSELLVILLE—Logan†
SALVISA—Mercer
SALYERSVILLE NORTH — Magoffin
SAMUELS—Nelson
SCRANTON—Menifee†
SEITZ—Magoffin
SOUTH UNION—Logan
WEST LIBERTY—Morgan†
WILMORE—Jessamine

Kentucky-Indiana

OWENSBORO EAST—Daviess
PATRIOT—Switzerland

Kentucky-Missouri

CARLISLE—Arlington

Kentucky-Ohio

NEWPORT—Campo

Kentucky-Tennessee

CRUTCHFIELD—Fulton
LYNNVILLE—Graves
OAK GROVE—Christian

Louisiana

CHALMETTE—Orleans
FARMERVILLE*—Union
HOMER*—Claiborne
LAKE CHARLES*—Calcasieu
SHELL BEACH*—St. Bernard
WEST DELTA*—Plaquemines

Maine

LEWISTON*—Androscoggin

Maryland-Delaware

ASSAWOMAN BAY—Worcester

Maryland-Virginia

GIRDLETREE—Worcester

Michigan

BLACK CREEK—Kalkasha†
DELAWARE‡—Keweenau†
IDA—Monroe

Minnesota

BUHL—St. Louis†
HIBBING—St. Louis†
ST. PAUL EAST—Ramsey
ST. PAUL WEST—Ramsey

Missouri

CEDAR GAP—Wright
IRONTON*‡—Iron
KIRKWOOD—St. Louis

Montana

ELTON—Park†
FAIRVIEW PEAK—Sweet Grass
GRANNIS—Park†
HOPPERS—Park†

Nebraska

CALLAWAY SE—Custer†
EDDYVILLE—Custer
EDDYVILLE SW—Custer
HAZARD—Sherman
OCONTO—Custer†
OCONTO SW—Custer
OCONTO SE—Custer

Nevada

GASS PEAK*—Clark†

Nevada-California

BIG DUNE*—Nye

New Mexico

AGUA FRIA—Santa Fe†
BAR C RANCH—Chaves†
BELEN—Valencia
HAGERMAN—Chaves†
LA JOYA NW—Socorro†
LOOKOUT MOUNTAIN*—Sierra
SANTA FE—Sante Fe
SETON VILLAGE—Santa Fe
TOME—Valencia†
TURQUOISE HILL—Santa Fe†

New York

BROCKPORT—Monroe
FURNACEVILLE—Wayne†
NINE MILE POINT—Monroe†
PULTNEYVILLE—Wayne†
SALMON CREEK—Wayne†
SCHUYLER LAKE—Otsego
STANLEY—Ontario
SYRACUSE EAST—Onondaga†
THERESA*—Jefferson†
TULLY—Onondaga

North Carolina

NORMAN—Richmond
SWANQUARTER—Hyde†

North Carolina- South Carolina

CALABASH—Brunswick

Ohio

RENO BY THE LAKE—Lucas†
ROSSFORD—Wood
WALBRIDGE—Ottawa

Ohio-Kentucky

HIGGINSPORT—Bracken
WEST CINCINNATI*—Hamilton

Oklahoma

CEMENT*—Caddo
NELLIE*—Stephens
SADDLE MOUNTAIN*—Kiowa
SNYDER*—Kiowa

Oregon

CORVALLIS*—Benton
HUNTINGTON*—Baker

Oregon-Idaho

MOORES HOLLOW*—Malheur

Pennsylvania

AMBLER—Montgomery
HATBORO—Montgomery
VALLEY FORGE—Chester
YOUNG WOMANS CREEK—Clinton

Pennsylvania-New Jersey

EASTON—Northampton

Puerto Rico

ADJUNTAS—Adjuntas
CAYO ICACOS—De Fajardo
CENTRAL AGUIRRE—Salinas
EL YUNQUE—Rio Grande
FAJARDO—Fajardo
GUAYAMA—Arroyo
GURABO—Gurabo
JAYUYA—Jayuya
MARICAO—Maricao
OROCOVIS—Orocovis
PATILLAS—Patillas
PENUELAS—Penuelas
PONCE—Ponce
PUNTA TUNA—Maunabo
YAUCO—Yauco

Rhode Island

KINGSTON‡—Washington†

South Carolina-Georgia

HARDEEVILLE*—Jasper

South Dakota

BADNATION NW—Mellette
CAPA NW—Stanley
FAIRBURN SE—Custer
KIMBALL NORTH*—Brule
LA PLANT—Dewey†
MURDO 3 NE—Mellette
MURDO 3 NW—Mellette†
NISLAND—Butte†
PRESHO 4 NE—Tripp
PRESHO 4 NW— Tripp

PUKWANA*—Brule
REDELM NW—Ziebach
ROCKYFORD—Shannon†
SHARPS CORNER—Shannon†
SMITHWICK SE—Fall River
VAN METRE—Jones
VIRGINIA—Dewey†
WESTOVER—Jones
WHITE RIVER NE—Mellette
WILLOW CREEK NE—Shannon†

Tennessee

BIG SANDY—Benton
BOYDS CREEK—Sevier
BRUCETON—Carroll
GATES—Lauderdale
HARMON CREEK—Benton
HENDERSONVILLE—Sumner
MANSFIELD—Henry
OSAGE—Henry†
PARIS—Henry†
STANDING ROCK—Stewart†
STEWART—Houston
VALE—Carroll†

Texas

ASHWOOD—Matagorda
BLESSING SE—Matagorda†
BLOOMINGTON—Victoria
BLOOMINGTON SW— Victoria
BROWN CEDAR CUT—Matagorda†
COLORADO CITY—Mitchell†
CRANE ISLANDS SW—Nueces
DANEVANG—Wharton
DECROS POINT—Matagorda
EAST COLUMBIA—Brazoria
HAWK ISLAND—Willacy
IRA NE—Scurry
LA PARRA RANCH—Kenedy
MATAGORDA SW—Matagorda
MAURICEVILLE—Orange
PLEDGER—Matagorda
POINT OF ROCKS—Kleberg
PORT LAVACA EAST—Calhoun†
RIVIERA BEACH—Kleberg
RIVIERA BEACH NE—Kleberg†
ST. CHARLES BAY SW—Aransas†
SARITA 4 NE—Kenedy†
SARITA 4 SE—Kenedy†
SOUTH BIRD ISLAND SE—Kleberg
SOUTH OF POTRERO LOPENO NE—Kenedy†
TERRY—Orange
TEXLA—Orange
VICTORIA EAST—Victoria†
WADSWORTH—Matagorda†
WEST COLUMBIA—Brazoria†

Utah

MIDVALE—Salt Lake†
SANTAQUIN*—Utah

Vermont

BURKE*—Caledonia

Virginia

MONETA*—Bedford
MULBERRY ISLAND—Warwick
RICHARDSVILLE—Culpeper
SHIP SHOAL INLET—Northampton

Virginia-W. Virginia

BERRYVILLE—Clarke

Washington

ANACORTES*—Skagit

Wisconsin

CHETEK*—Barron
MERCER*—Iron

Wyoming

BEAR MOUNTAIN—Natrona
BOYSEN—Fremont
DEAD INDIAN HILL—Big Horn
EAGLE POINT—Fremont
GILLIES DRAW—Park
LONE MOUNTAIN—Natrona†
LYSITE—Fremont†
OTTO—Big Horn†
SHEETS FLAT—Park†
SPLIT ROCK—Natrona
SPLIT ROCK NW—Fremont
WARDEL RESERVOIR — Big Horn†

Wyoming-South Dakota

DEWEY—Custer
FANNY PEAK—Weston
TWENTYONE DIVIDE—Natrona

In addition to the standard series of quadrangle maps, reconnaissance maps at the scale of 1:250,000 are being published for both the continental United States and Alaska. The maps in this series published in the period are:

Alaska

ADAK‡—First Judicial Division
BRADFIELD CANAL‡ — First Judicial Division†
MOUNT FAIRWEATHER—First Judicial Division†
MOUNT McKINLEY NATIONAL PARK‡—Fourth Judicial Division
NAKNEK—Third Judicial Division
SUMDUM‡—First Judicial Division
TAKU RIVER‡—First Judicial Division

Alaska-Canada

SKAGWAY‡—First Judicial Division

Georgia, North Carolina, South Carolina and Tennessee

SAVANNAH

California, Nevada, Arizona and Mexico

LOS ANGELES

Public Land Survey Plats

THE FOLLOWING plats of public land surveys and resurveys were completed and accepted by the Bureau of Land Management, U. S. Department of the Interior, between June 1 and August 31, 1953. The class or purpose of the survey is indicated. Copies of the plats may be secured from the Bureau Offices in the State or from the Director, Bureau of Land Management, Department of the Interior, Washington 25, D. C.

Alaska

Municipal Airport, Circle Hot Springs—U. S. Survey 3232
Municipal Airport, Eagle—U. S. Survey 3190
Municipal Airport, Haines—U. S. Survey 3151
Bird Creek Small Tract Group—U. S. Survey 3201
Bird Creek Small Tract Group—U. S. Survey 3202
Cantwell Townsite—U. S. Survey 3203 A and B
Cantwell Small Tract Group—U. S. Survey 3229
Elfin Cove Group Homesites—U. S. Survey 2953
Elfin Cove Group Homesites—U. S. Survey 2954
Elfin Cove Group Homesites—U. S. Survey 2955
Elfin Cove Group Homesites—U. S. Survey 2956
Ft. Yukon Townsite—U. S. Survey 2760 A and B
Portage Small Tracts—U. S. Survey 3188
South Point Higgins Group Homesites—U. S. Survey 3152
Yakutat Townsite 2nd Addition—U. S. Survey 3241 A and B

Alaska—Copper River Meridian

T. 28 S., R. 53 E., subdivision of section
T. 28 S., R. 54 E., subdivision of section
T. 28 S., R. 55 E., subdivision of section
T. 28 S., R. 56 E., subdivision of section
T. 29 S., R. 57 E., dependent resurvey and subdivision of section
T. 30 S., R. 58 E., subdivision of section

Arizona—Gila and Salt River Meridian

T. 15 S., R. 12 E., subdivision of sections
T. 7 S., R. 16 W., reclamation (farm unit)
T. 8 S., R. 16 W., reclamation (farm unit)
T. 7 S., R. 17 W., reclamation (farm unit)
T. 8 S., R. 17 W., reclamation (farm unit)
T. 8 S., R. 18 W., reclamation (farm unit)
T. 13 S., R. 31 E., resurvey
T. 14 S., R. 31 E., resurvey

Colorado—New Mexico Principal Meridian

T. 44 S., R. 8 W., subdivision of sections

Florida—Tallahassee Meridian

T. 18 S., R. 20 E., island survey
T. 66 S., R. 31 E., island survey
T. 66 S., R. 32 E., island survey

Idaho—Boise Meridian

T. 8 S., R. 23 E., reclamation (farm unit)
T. 9 S., R. 23 E., reclamation (farm unit)
T. 9 S., R. 24 E., reclamation (farm unit)

Montana—Principal Meridian

Ts. 1 & 2 S., R. 12 E., dependent resurvey (part)
T. 6 S., R. 41 E., resurvey
T. 7 S., R. 41 E., resurvey
T. 7½ S., R. 41 E., resurvey
T. 5 S., R. 42 E., resurvey
T. 6 S., R. 42 E., resurvey
T. 4 S., R. 43 E., resurvey
T. 5 S., R. 43 E., resurvey
T. 6 S., R. 43 E., resurvey
T. 1 N., R. 44 E., resurvey
T. 2 N., R. 44 E., resurvey
T. 1 S., R. 44 E., resurvey
T. 2 S., R. 44 E., resurvey
T. 3 S., R. 44 E., resurvey
T. 4 S., R. 44 E., resurvey
T. 2 N., R. 45 E., resurvey
T. 2 N., R. 46 E., resurvey
T. 3 N., R. 46 E., resurvey
T. 4 N., R. 46 E., resurvey
T. 7 N., R. 46 E., resurvey
T. 3 N., R. 47 E., resurvey
T. 4 N., R. 47 E., resurvey
T. 5 N., R. 47 E., resurvey
T. 6 N., R. 47 E., resurvey
T. 7 N., R. 47 E., resurvey
T. 8 N., R. 47 E., resurvey
T 5 N., R. 48 E., resurvey

Nevada—Mount Diablo Meridian

T. 20 S., R. 60 E., subdivision of sections
T. 21 S., R. 60 E., subdivision of sections
T. 21 S., R. 61 E., subdivision of sections

New Mexico—New Mexico Principal Meridian

T. 13 S., R. 12 E., resurvey Mescalero Indian claims
T. 18 S., R. 13 W., Bayard Land transfer

Utah—Salt Lake Meridian

T. 2 N., R. 1 E., partial resurvey

Wisconsin—Fourth Principal Meridian

T. 39 N., R. 9 E., omitted land survey
T. 40 N., R. 9 E., omitted land survey
T. 40 N., R. 10 E., omitted land survey

Wyoming—Sixth Principal Meridian

T. 50 N., R. 79 W., resurvey
T. 49 N., R. 80 W., resurvey
T. 53 N., R. 80 W., resurvey
T. 21 N., R. 88 W., subdivision of section
T. 39 N., R. 144 W., extension survey

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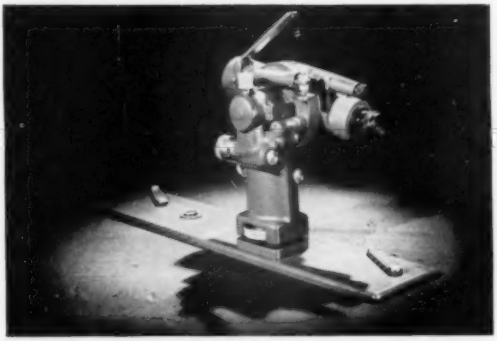

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Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way.

—EDITOR

PUBLIC LAND SURVEY PLATS

P. N. SCHERBEL*—As an addition to the "Map Information" department of SURVEYING AND MAPPING may I suggest the inclusion of a notice of availability of General Land Office (Bureau of Land Management) township plats similar to that for USGS quadrangle maps. For those members who work where BLM surveying and resurveying are in progress, it would be advantageous to know when these township plats are completed and available. I know of no source of this information without specific inquiry to the Bureau of Land Management.

(EDITOR'S NOTE.—The Publications Committee agreed with Mr. Scherbel's suggestion and contacted the Bureau of Land Management through the good offices of C. S. Maltby. That bureau indicated that it would cooperate completely, and immediately gave concrete evidence of its cooperation by submitting a tabulation of public land survey plats for the period June 1–Aug. 31, 1953. The tabulation appears in this issue under "Map Information.")

* Registered Land Surveyor, Big Piney, Wyo.

TITLE MAN MEETS THE CHALLENGE

HUGH A. BINYON‡—Your "Challenge to Title Men," on page 341 of the July–September 1953 issue of SURVEYING AND MAPPING is hereby met. And considering the date (1946), amount of consideration ($600.00), the fact that we *know* it is actually a legal document, and the fact it is a Florida product, we believe it more than meets the challenge.

Since it annoys us, we are sure the following warranty deed description will prove a "stinker" to any surveyor attempting to stake the land described:

. . . WITNESSETH, that the said grantors, in consideration of Six Hundred and No/100 Dollars, the receipt whereof is hereby acknowledged, do give, grant, bargain, sell, alien, remise, release, enfeoff, convey, and confirm unto the said grantee and his heirs and assigns in fee simple, the lands situate in Citrus County, State of Florida, described as follows:

A certain tract of land described as follows: Beginning at a point about one foot east of where a certain toilet sits but not on the land described herein, and run through the middle of a marsh southwesterly to a point on Salt River, thence following the meanderings of said river southwesterly and thence northwesterly to the section line, the same being that part of the property hereinafter described upon which the grantee has his house erected, and all of the lands west of the center of the marsh of that certain tract of land described as two acres in the northwest corner of Government Lot 2, of section 36, township 19 south, range 16 east in Citrus County, State of Florida, and being approximately one-fourth of an acre. It being distinctly understood that the starting point shall be at the center of the dock and run thence northeast to a point approximately one foot east of the line where said toilet is now sitting. TO HAVE AND TO HOLD. . . .

Filed and recorded December 23, 1946, and record verified.

‡ Engineer, West Coast Title Company.

PLASTIC OR GLASS ENGRAVING VERSUS DRAFTING

S. E. REILLY*—In the account of the Thirteenth Annual Meeting in the latest issue of SURVEYING AND MAPPING, Vol. XIII, No. 2, mention is made of a panel of the Cartography Division on "Plastic or Glass Engraving Versus Drafting." Is this likely to be published in the Journal, and if not, is it possible to obtain any further details of the deliberations of this panel?

Congratulations on the high standard reached in recent issues of the Journal. I found the paper on contour interval problems particularly interesting.

* Member ACSM, South Brisbane, Queensland, Australia.

(EDITOR'S NOTE.—The Chairman of the Publications Committee replied to Mr. Reilly's communication, in part as follows:

"Because of the length of the panel discussion on "Plastic or Glass Engraving Versus Drafting," it will not be possible to publish the material in full. We plan, instead, to print a summary of developments in the field. Such a summary is now being prepared by the moderator of the panel.[1] In the meantime, we are forwarding, by regular mail, copies of papers presented as part of the panel, plus certain additional material.")

[1] *See* Recent Developments in Negative Scribing, by Charles F. Fuechsel, moderator of the panel discussion, in this issue.

New Jersey Land Surveyors Conference

THE Fourteenth Annual Land Surveyors Conference and Exhibition sponsored by the Land Surveyors Division of the New Jersey Society of Professional Engineers will be held Saturday, January 23, 1954, at the Rutgers University Commons, New Brunswick, N. J.

The program in general plan will follow the successful arrangement of the last two years. The keynote address will be delivered by Paul H. Robbins, Executive Director of the National Society of Professional Engineers on the very important subject, "The Surveyor's Status in the Society." Another topic to be presented and discussed is the new New Jersey law on subdivision and filing of maps which will be effective Jan. 1, 1954. The related new planning law will also be discussed. Committees of the newly created Land Surveyors Division will report their activities and plans.

The conference of a year ago attracted a registered attendance of 225, largely from New Jersey.

There were 21 exhibitors of surveying equipment and services, including several of the sustaining members of the American Congress on Surveying and Mapping. For the past two years an exhibit space has been allotted to the Congress containing membership blanks, literature, and examination copies of the Journal, with a backdrop of Congress posters. Additional space has been secured this year to increase the exhibitors to 27 or 30.

A new feature, introduced last year and to be continued, is the presentation of door prizes. The exhibitors donated 48 prizes having general usefulness to surveyors, such as drawing sets, a slide rule, a plumb bob, plumb bob targets, a T-square, tapes, a hand level, and a pocket compass, having a retail value of over $300. With more exhibitors it is anticipated the number, variety, and value of these prizes will increase.

It is expected that the final printed program will be available shortly after the first of the year. Persons desiring a copy should forward a stamped addressed envelope to the Secretary of the Land Surveyors Division of the New Jersey Society of Professional Engineers, Prof. Paul P. Rice, College of Engineering, Department of Civil Engineering, Rutgers University, New Brunswick, N. J.

News of Related Organizations

New Hampshire Society of Engineers

An exhibit of old and new surveying equipment supplemented by a two-hour discussion on surveying subjects featured a meeting of the New Hampshire Society of the New Hampshire Engineers on September 19, 1953, at Laconia, N. H. Based on the unusual amount of interest shown, it was decided to hold an all-day meeting during the winter. Gerald Hyde, a consulting forester of Nashua, N. H., who reported the meeting, indicates that there is a growing interest in the New Hampshire Society and in the American Congress on Surveying and Mapping.

The Society now has about 40 members.

Texas Surveyors Association

Approximately 225 members attended the 3-day annual meeting of the Texas Surveyors Association, held in Austin on October 12, 13, and 14. The meeting featured the election of officers for 1954 on the opening day, followed by a 2-day Surveyors Short Course.

In the election, E. D. Morse of Houston, 1953 Chairman of the Texas Section ACSM, was elected President to succeed Hugh L. George of San Angelo.

Other officers named were Fred Williamson of Temple, First Vice President; Frank T. Drought of San Antonio, Second Vice President; J. D. Freeman of Austin, Third Vice President; and William Shiriffs of Austin, Secretary-Treasurer.

Directors named were B. T. Rucher of Lubbock, Charles Klumpp of Kenedy, Charles P. McKnight of Houston, Clayton H. Uran of Waco, and Arch Clark of Dallas.

Texas Land Commissioner Bascom Giles presided at the opening session of the short course and discussed provisions of the Tideland Bill. Papers given the first day included "The Junior College for Increase in Land Survey Education," "San Antonio Precise Control Surveying," "West Texas Surveying Problems," and "Aerial Photography from the Surveyor's Viewpoint."

An explanation of the proposed registration act for Texas surveyors, how trees figure in Texas surveys, and procedures necessary to prepare a boundary case for trial in court were among the subjects for discussion on the second day of the short course.

One of the features of the meeting was the display by eleven exhibitors of surveying and office equipment and of aerial photography, which was held on the mezzanine floor of the Stephen F. Austin Hotel.

President-elect Morse commented on the fact that two speakers at the meeting had found occasion to quote from SURVEYING AND MAPPING. He outlined the purpose of ACSM and commented on the progress made through its years of activity, especially through the publication of high quality articles in its quarterly.

FORREST DANIELL

Georgia Association of Registered Land Surveyors

An August meeting of the Georgia Association of Registered Land Surveyors was held in Macon, Ga., where a large group heard an interesting program which included a panel discussion on the functions of the Membership Committee. Further discussion centered on the publication of a yearbook in which it is planned to include the names and addresses of GARLS members as well as a description of the association, its aims and accomplishments.

Members witnessed an interesting demonstration of a new pocket calculator designed for rapid computing in the field.

H. O. Robison
Secretary

Wisconsin Society of Land Surveyors

The summer meeting of the Wisconsin Society of Land Surveyors was held on August 2 at Lakeside Park in Fond du Lac.

President Mecha in his opening remarks cited the progress made by the Society during the past year and urged the members to publicize the Society throughout the State.

The activities of the Legislative Committee were next outlined by R. P. Boyd. Although the Land Surveyors' Registration Bill failed of enactment, the Metes and Bounds Bill was passed by the Legislature. A copy of this new law, together with all pertinent 1953 legislation, was sent to all WSLS members in September.

Mr. Boyd further reported on his trip to the ACSM Annual Meeting in Washington, D. C.

East Bay Council on Surveying and Mapping

A meeting of the East Bay Council on Surveying and Mapping was held at Hayward, Calif., on September 14 under the Chairmanship of R. C. Kennedy.

A substantial part of the meeting was devoted to the presentation of revised technical reports on several subjects including "Suggested Procedures for Making Local Ties to the California Coordinate System," "Field and Computation Forms," "Recommended Checking Procedures," "Specifications for Control Surveys," "Local Ordinance for Monument Protection," and "The Value of Control." Future reports, now under study by the Technical Committee, include: "Index of Existing Maps," "Special Equipment," "Map Scales," "Contract Survey Specifications," and "Coordinates on Maps and in Deeds."

C. A. Wooldridge, Jr., reported the progress of Alameda County in compiling files of control monument data. There are about 500 points included in the index to date, with probably 1,000 more to be incorporated as soon as possible. This information is being kept up to date and copies of this horizontal and vertical data are available through the County Surveyor's office.

Prof. F. H. Moffitt described the University of California tape calibration range, to be completed in the near future, and later outlined the University extension course, "Control Surveys and the California Coordinate System," to be given at the request of the East Bay Council.

Work of the Classification Committee was reported by Chairman Nacadegawa. This committee was created primarily to review and pass upon the acceptability of surveys as supplemental control.

The members present voted unanimously in favor of affiliation with the American Congress on Surveying and Mapping.

The meeting was concluded with the showing of a color movie showing the various operations and responsibilities of the U. S. Coast and Geodetic Survey, presented through the courtesy of Captain George C. Anderson, Director of the San Francisco office of the Coast Survey.

C. A. Wooldridge, Jr.
Secretary

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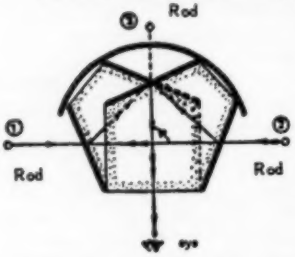

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CONGRESS NEWS

New Officers for 1954

The Tellers Committee, composed of Chairman Albert C. Kalbfleisch, William B. Sears, and Julius L. Speert, reports that balloting resulted in the election of the following as officers for 1954:

Officers

Carroll F. Merriam, *President*
William C. Wattles, *Vice President*

Directors
(Two-year terms)

Gordon E. Ainsworth Robert H. Randall, Jr.
Benjamin E. Beavin, Sr. Paul P. Rice
Arthur J. Sweet

Brief biographies of the new officers and directors were given in the July–September 1953 issue of SURVEYING AND MAPPING.

Fall Meeting of Washington Group

Nearly 500 members and guests of ACSM attended an informative and entertaining meeting at the Interior Department Auditorium in Washington on Nov. 5, 1953.

A United Nations motion picture "Maps We Live By," was presented. This film demonstrates the importance of maps to all peoples of the world and the role played by maps in enabling people to live peacefully together. The film was made available from the U. S. Air Force Library through the courtesy of the Aeronautical Chart and Information Center.

William A. Foster of the Hydrographic Office, U. S. Navy, spoke on "Hydrographic Surveying." In his talk, Mr. Foster outlined the history of the Hydrographic Office and described the latest developments and techniques in hydrographic charting.

William E. Davies of the U. S. Geological Survey gave an illustrated lecture on "Summer in Greenland." With the help of an abundance of excellent color slides, Mr. Davies described a recent mission in Greenland for geologic and topographic studies.

The program was sponsored jointly by ACSM's Technical Divisions on Cartography, Education, and Topography. Robert L. Moravetz, Chairman of the Cartography Division, presided.

MORRIS M. THOMPSON

Notice to Sustaining Members

The Executive Committee of ACSM, at its meeting of August 11, 1953, decided that sustaining members should be listed in future issues of the Journal in non-advertising form in accordance with Postal Regulations, this change in the manner of listing to take place with the first issue of 1954.

Accordingly, beginning with the January–March 1954 issue of the Journal, the sustaining members professional cards will be eliminated. Instead, the members will simply be listed by name and address.

ACSM Business Meetings

Since last reported, in the January–March 1953 issue of the Journal, the ACSM Executive Committee[1] held meetings on March 11, May 26, and August 11, and the Board of Direction held one meeting, on March 26, 1953.

At the Executive Committee meeting on March 11, 1953, the following business of interest to all members was conducted:

(1) It was decided that recommendations to the Board in matters of trends and growth in affiliations as well as student chapter considerations should be under the guidance of the ACSM Constitution Committee.

(2) The Executive Committee authorized the Publications Committee Chairman, together with the Chairmen of Membership and Budget Committees and Property Surveys Division, to republish selected ACSM Property Survey articles under copyright for resale to members and interested public.

(3) Chairman K. T. Adams of the ACSM "space" committee reported that this committee, as instructed by the Board, had met with a similar group from the American Society of Photogrammetry to examine possible quarters in a resident building presently occupied by the Association for Advancement of Science. Chairman Adams recommended that ACSM not consider this space, as the top floor quarters were not too desirable and AAS future building plans were uncertain.[2]

(4) Chairman Amstadt distributed copies of his proposed budget for 1953 together with financial reports for 1952. After study and discussion, these were adopted as proposed.

A Board of Direction meeting was held on March 26, 1953, at which plans were discussed for the ACSM 1954 Annual Meeting.

Helmuth Bay was appointed to be General Chairman of the annual meeting. Vice President Beavin's committee was asked to investigate the possibilities of holding ACSM and American Society of Photogrammetry meetings consecutively in the same week in 1954 or 1955.

At the Executive Committee meeting on May 26, 1953, the following business of interest was conducted:

(1) President Studds reviewed the activities of ACSM sections, described the Northern California Section's spring meeting and complimented the progressive spirit and good work of the West Coast and the Texas Sections, as evidenced on his trip through these areas.

(2) Secretary Dix reported that Capt. H. Arnold Karo of USC&GS had been nominated to replace C. H. Davey of the Geological Survey as ACSM representative to the National Research Council, that ACSM was represented by Georges Côte at the 1953 Annual Meeting of the Quebec Corporation of Land Surveyors, and that Sol A. Bauer, former ACSM President, represented the Congress at the inauguration of G. Brooks Earnest as the third president of Fenn College.

He also reported that the Surveying and Mapping Section of the Florida Engineering Society had acted in favor of affiliation with ACSM.

(3) Chairman M. Y. Poling presented a prepared report of financial accounting of the 13th Annual Meeting.

Considerable discussion followed concerning the advisability of retaining certain features of the meetings and the matter was continued as unfinished business to allow the Executive Committee members sufficient time to study Mr. Poling's recommendations.

(4) Deputy Chairman Williams reported that although it is not feasible to hold a cooperative continuous meeting with the American Society of Photogrammetry in 1954, committees from the two societies would meet shortly to discuss the 1955 possibilities.

(5) Secretary Dix reported that the Constitution Committee had practically completed the first draft of the constitutional revisions. This is to be presented to the Board of Direction for approval before submitting to the vote of the membership.

(6) Chairman Helmuth Bay reported that Robert H. Randall, Jr., has been appointed as Program Chairman of the 14th Annual Meeting.

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[1] The Executive Committee of ACSM is composed of the President, who serves as Chairman; the Vice President; the Executive Secretary; the Treasurer; the Editor-in-Chief; the out-going Past-President; and one or more Directors appointed by the Board of Direction. The Executive Committee meets at such times as may be deemed necessary by the Chairman to perform delegated duties and administer such matters as arise when the Board of Direction is not in session.

[2] The American Society of Photogrammetry also did not accept this space and located elsewhere.

(7) General plans were discussed for publishing at a later date a Property Surveys Division Handbook based on copyrighted material first published in the ACSM Journal. Several offers have been received from recognized publishing houses interested in publishing such a handbook.

At the Executive Committee meeting on August 11, 1953, the following general business was conducted:

(1) Secretary Dix read the slate of 1954 candidates recommended by ACSM's Nominating Committee, composed of Chairman Marshall S. Wright and Members Helmuth Bay and Franklin G. Williams. The slate was approved unanimously.

(2) The Executive Committee approved the affiliation of the Land Surveyors Association of King County, Washington, as an institutional member of ACSM.

(3) ACSM Past-President Marshall S. Wright, Sr., was delegated to represent ACSM at the Eighth International Congress of Surveyors in Paris. Mr. Wright expected to be in Paris on business at the time of this meeting.

(4) The financial report and list of recommendations of the ACSM 13th Annual Meeting was reviewed and thoroughly discussed, following which the report was accepted.

(5) Deputy Chairman Williams reported on the possibilities of a 1955 ACSM-ASP cooperative meeting. A meeting of the committees of the two societies was held on May 27 and although both committees were in general agreement as to the desirability of such a meeting, a temporary stalemate was encountered in establishing a date for the meeting. The matter is to be discussed further in the respective societies and an attempt to reach a satisfactory solution will be made at a future date.

(6) Chairman William T. Pryor reported that a rough draft of the work of the Constitution Committee had been distributed to members of the committee for study and comment and that he planned to submit a proposed draft to the Board of Directors for approval at an early date.

(7) The Executive Committee gave blanket approval to operational procedures concerned with producing the ACSM Property Surveys Division Handbook. These procedures were outlined by ACSM Publications Committee Chairman Thompson in a letter to Sol A. Bauer, Chairman of the Handbook Committee, and proposed a system for originating, editing, publishing, and copyrighting the Handbook material.

Texas Section

The Tenth Meeting of the Texas Section of ACSM was held on September 25, 1953, in the auditorium of the Houston Lighting and Power Company Beatty Service Center Building. Fifty-seven members and twenty-four visitors were present.

In his opening remarks, Chairman Morse urged all ACSM members to attend the Second Annual Texas Surveyor's Association Short Course to be held in Austin, Texas, on October 13 and 14.

After the introduction of guests, Chairman Morse turned the meeting over to W. H. Wilson, Chairman of the Program Committee, who introduced the speaker, F. D. Smith, Division Surveyor for Humble Oil & Refining Company, Tyler, Tex. The subject of Mr. Smith's address was "Surveying Wildcat Lease Blocks in Texas."

Mr. Smith emphasized the necessity of a good working sketch of General Land Office information and the necessity of adequate deed record information. His talk covered the location of surveys, excess within those surveys, and vacancies between those surveys. Mr. Smith also explained the steps needed to complete filings with the General Land Office of Texas on vacancies and excess.

Following his address, Mr. Smith answered many questions pertaining to surveying problems in Texas.

C. P. McKnight, member of Texas Section, ACSM, and a member of the Committee on Surveying and Mapping, Texas Society of Professional Engineers, gave a report on the latest actions of TSPE regarding proposed legislation for the registration of surveyors in Texas. Mr. McKnight stated that the Committee on Surveying and Mapping of TSPE has been studying the proposed legislation. He suggested that all technical societies interested in the proposed legislation cooperate to iron out all objectionable features of the proposed legislation, in order that the surveying profession might present a united front in support of the bill.

HODGE E. MASON
Secretary

Southern California Section

The Southern California Section of ACSM held a meeting at the General Petroleum Auditorium in Los Angeles on September 29 at which Czerny Anderson, licensed land surveyor, spoke on "Legal Elements of Surveying" and "The Use of Photogrammetry and the California Coordinate System in the Establishment of Land Boundaries."

On November 7, the Technical Standards Committee of the Section presented an interesting cartographic display at the Los Angeles City Hall. In addition to an assembly of outstanding maps, instruments, and materials, a movie, "Preparation of Map Manuscripts for Reproduction," was shown.

Northern California Section

A special meeting was called in Sacramento on September 18, to hear Gerald FitzGerald, Chief Topographic Engineer of the Geological Survey, speak on "Maps—Yesterday, Today and Tomorrow." Mr. FitzGerald, 1951 ACSM President, reviewed some of the early surveys of the West in addition to describing present-day mapping activities of the Geological Survey.

The Property Surveys Division held a joint meeting with the East Bay Council on Surveying and Mapping, an ACSM affiliate, in Richmond in October. Professor F. H. Moffitt spoke on the California Coordinate System, explaining the Lambert conformal conic projection, how simple it is to use, and describing a few of the benefits. He commented on the increased interest and use of the coordinate system in Northern California, especially in the San Francisco Bay area.

The annual meeting was held in Sacramento in November. As an experiment, this meeting was held Saturday afternoon, with an interesting series of speakers on "Maps." C. O. Greenwood, Jr., spoke on surveying maps and methods of production, William Warren on survey and map requirements, and T. L. Atherton on surveying and mapping specifications.

Results of the election of officers for 1954 were announced at the annual meeting as follows:

Logan N. Muir, Jr., *Chairman*
C. A. Wooldridge, Jr., *Vice Chairman*
Roland H. Moore, *Secretary-Treasurer*
H. A. Waterfall, *Editor*
Directors (1954–5)
C. O. Greenwood, Jr.
W. A. Angeloni

C. A. Wooldridge, Jr.
Secretary

Personals

Marshall S. Wright, Sr., a Past-President of ACSM who recently retired from the Department of Agriculture, has been appointed the Washington representative of the Transmares Corporation—sole representatives for Zeiss Aerotopograph, Munich, Germany.

Mr. Wright will spend a few months in France and Germany. Upon his return to the USA, it is expected that an office and display room will be opened in downtown Washington.

George H. Harding, the first Executive Secretary and later President of ACSM, has accepted an assignment for the Pan American Institute of Geography and History as Consultant-Organizing Director to set up a new training center for the evaluation of natural resources. The training center is being established on the campus of the Universidade Rural, Rio de Janeiro, Brazil, under the provisions of Project 29 of the Organization of American States. Professor Harding began his organizing mission in October 1953 and expects to complete the assignment in from four to six months, at which time he will return to the United States.

Professor Harding was responsible for the establishment and organization of the Mapping and Charting Research Laboratory and the Institute of Geodesy, Photogrammetry and Car-

tography at the Ohio State University, where he served as Director of both organizations until his resignation became effective with the Laboratory on July 1, and the Institute on October 1, 1953.

Dr. William E. Wrather, Director of the Geological Survey, Interior Department, has been awarded the John Fritz Medal, which is described as the "highest award of the engineering profession," for his work as a "geologist of worldwide experience and fame."

The award was made jointly by the American Society of Civil Engineers, American Institute of Mining Engineers, American Institute of Electrical Engineers, and the American Society of Mechanical Engineers.

Dr. Wrather was appointed Director of the Geological Survey in 1943. He first joined the bureau after graduating from the University of Chicago in 1907.

❦ ❦ ❦

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Applicant's Signature ..... Date .....

NEW MEMBERS

INDIVIDUAL MEMBERSHIPS

AMBLE, Wilfred D., 1903 W. 73rd St., Seattle, Wash.—Design Engineer, Corps of Engineers
ARRINGTON, William D., c/o Geophysical Service Inc., 6000 Lemon Ave., Dallas, Tex.—Surveyor
AVANS, Harry L., 2155 Glenada Ave., Montrose, Calif.—Draftsman, J. M. Montgomery & Co., Inc.
BELL, James L., Box 224, Mission, Kans.—Owner, James L. Bell & Co., Surveyors and Engineers
BIZZELL, A. W., Newton Grove, N. C.—Surveyor
BROMS, Gerald P., 11324-A West Washington Pl., Culver City, Calif.—Computer, C. W. Cook Corp.
CASSIDY, Lt. Col. Frank P., 30th Engr. Topo. Bn., Fort Winfield Scott, San Francisco, Calif.
CHONG, Wing On, 400 Marston Ave., San Francisco, Calif.—Senior Engineering Aid, State of California
COOK, Arthur F., Room 10, Court House, The Dalles, Oreg.—Wasco County Road Dept.
COOK, William H., 439 Park Ave., Long Beach 14, Calif.—Chief, Photogrammetric Division, J. H. Davies and Associates
DELANO, Robert B., Summer St., R. F. D. 179, Duxbury, Mass.—Civil Engineer and Surveyor
DELY, George F., 4869 Cope Ave., Detroit, Mich.—Surveyor, McMahon Engineering Co.
DUCHESLOVE, Will A., 120 W. Main St., St. Clairsville, Ohio—General Surveying, Ducheslove Surveying Co.
EVANS & MECHWART, Gahanna, Ohio—Civil Engineers and Surveyors
FORREST, Glenn L., 50 Columbia St., Mohawk, N. Y.—Village Engineer, Ilion, N. Y.
FRANK, John E., 153 Edison Dr., Huntington, W. Va.—Civil Engineer, Corps of Engineers
GILLESPIE, William J., 207 Willow St., Chincoteague, Va.—Civil Engineer, U. S. Navy
GLASS, Charles E., 2144 Nottingham Rd., East Meadow, N. Y.—Land Surveyor
GOOCH, Joseph H., 102½ W. Dunbar St., Spartanburg, S. C.—Partner, Gooch and Taylor
GRAVELLE, Warren G., Route 4, Box 415, Chico, Calif.
HARPER, H. MacDonald, U. S. S. *Maury*, c/o FPO, New York, N. Y.—U. S. Navy Hydrographic Office
HEACOCK, Lester P., 914 W. Pine St., Santa Ana, Calif.—Surveyor, Corps of Engineers, U. S. Army
JACKMAN, Richard J., 114 Chestnut St., Pasadena, Calif.—Student, Pasadena City College
KOUBA, Arthur W., County Engineer's Office, Cleveland, Ohio
LANE, James R., Jr., 7407 Glencove Pl., Lockhaven, Norfolk, Va.—Engineering Draftsman, U. S. Naval Base
LEAMAN, William D., 4628 NE. Campaign St., Portland 13, Oreg.—Civil Engineer, Bonneville Power Administration
LEWIS, Dr. George R., 901 Wood St., Clarion, Pa.
LLOYD, Douglas I., 4015 Marquette St., Houston, Tex.—Party Chief, E. S. and R. M. Atkinson
LOCKARD, Bruce H., PO Box 3127, H Street Annex, Bakersfield, Calif.—Civil Engineer, The Texas Co.
LOVELL, Forest W., PO Box 307, McDonough, Ga.—County Surveyor and Highway Project Engineer
LUCKETT, Joseph S., PO Box 732, El Paso, Tex.—Land Surveyor
MAWHINNEY, Richard A., 41 Water St., Machias, Maine—Surveyor
McGIRK, Lon S., Jr., Mackay School of Mines, Reno, Nev.
OSTER, William E., Jr., 1126 E. 7th St., National City, Calif.—Student, San Diego State College
PACE, George M. 7083 Paddison Rd., Cincinnati 30, Ohio—Civil Engineer and Surveyor
PEARSON, Maj. Alexander R., Eng. Sec., Hq. AFFE, APO 313, c/o Postmaster, San Francisco, Calif.
POSTMA, Gracia, Division of Highways, 120 S. Spring St., Los Angeles 12, Calif.—Highway Delineator, State of California
RAINWATER, L. M., Bldg. 25, Federal Center, Denver, Colo.— Cartographer, U. S. Geological Survey
ROBINSON, John H., 3405 State St., Erie, Pa.,—Engineer and Surveyor
ROECKER, Arthur, 1101 E. El Camino Ave., North Sacramento, Calif.—Senior Engineering Assistant, Muir and Train
SAMMONS, Capt. Jack C., U. S. Coast and Geodetic Survey, 518 E. 32nd St., Baltimore, Md.
SAPP, Clarence H., 1207 Grand Ave., Kansas City, Mo—Office Engineer, The Tuttle-Ayers-Woodward Co.
SCHNEIDER, E. J., Engis Equipment Co., 431 S. Dearborn St., Chicago, Ill.—Vice President
SHANER, Ryburn C., 4019 River Dr., Houston, Tex.—Consulting Engineer, Ryburn Shaner Engineering Co.
SMITH, J. Harold, Route 2, Molena, Ga.—Land Surveyor
SPENCER, Raymond E., 6606 Gale Ave., Long Beach 5, Calif.—Student, Civil Engineer
STOCKDALE, Donald R., 234 Brotherhood Bldg., Kansas City, Kans.—Engineer, private practice.
TRAIN, Timothy S., 3313 Haggin Dr., North Sacramento, Calif.—Partner, Muir and Train, Surveying and Engineering
VAN KOUGHNET, William N., 126 Yale Dr., Toledo 14, Ohio—Project Engineer, Libbey-Owens-Ford Glass Co.
WENDLER, Fred H., 1534 W. Gage Ave., Los Angeles, Calif.—Surveyor, Los Angeles County Road Department
WILLIAMS, Rolland C., 9382 Colegio Dr., Los Angeles, Calif.—Party Chief, Seaboard Engineering Corp.
WINTERS, Robert J., 34 Normal Ave., Upper Montclair, N. J.—Coordinator of Engineering, Port of New York Authority

Notice to All Members

Now is the time to remind non-members known to be interested in surveying and mapping of their responsibility to support the efforts being made by ACSM to improve the status of the profession. Until March 31, 1954, new members will receive one 1953 Journal, in addition to full membership for 1954. Note that professional dues constitute a legal deduction on Federal income tax returns. Application blanks may be obtained from the Chairman, Membership Committee, P. O. Box 6244, Washington 15, D. C.

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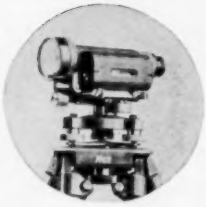

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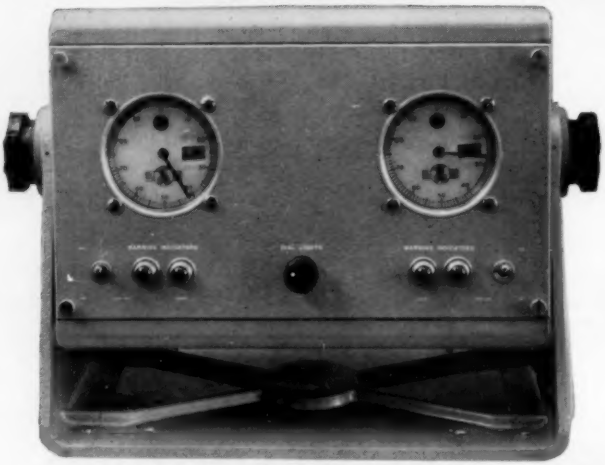

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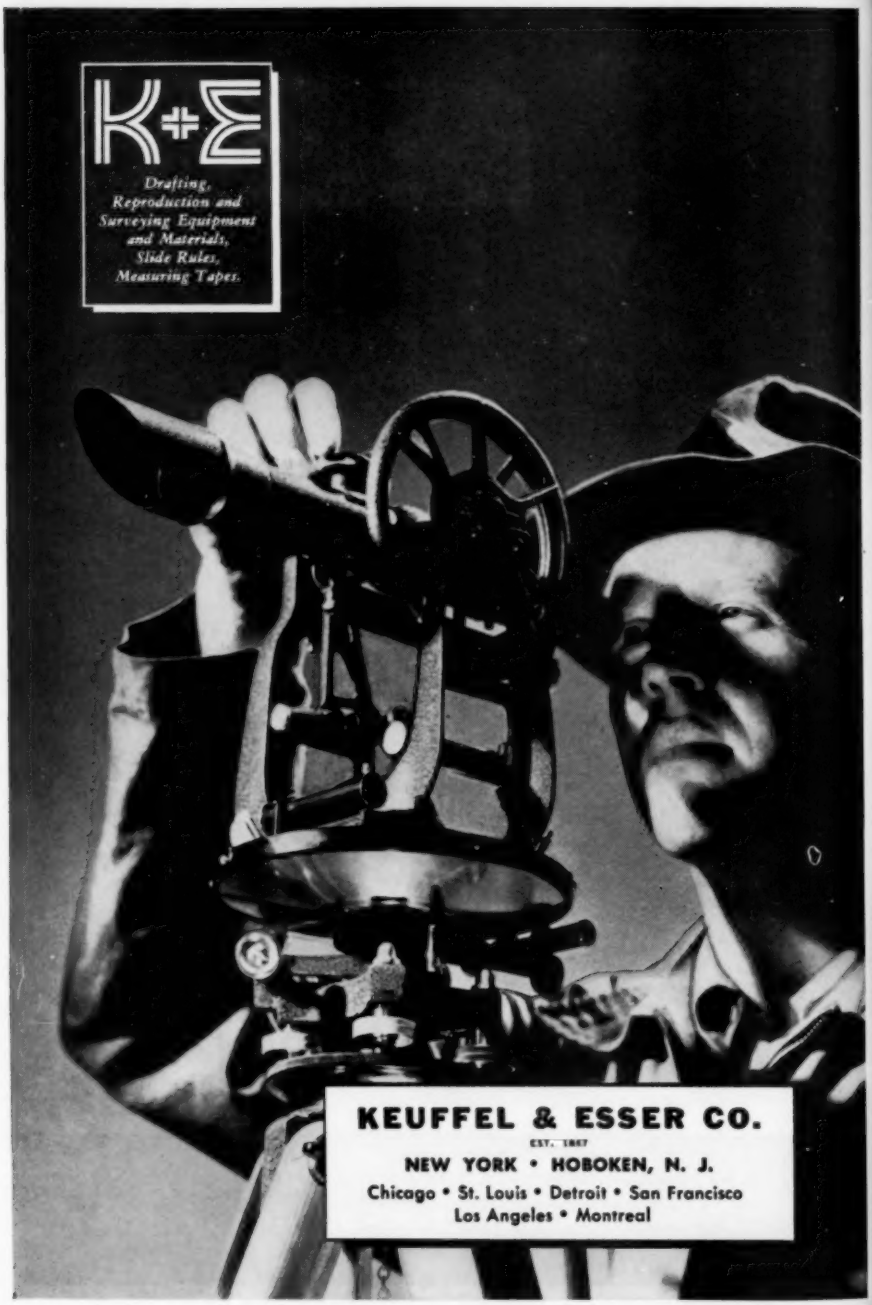
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